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(71) Applicant and

(72) Inventor: **BURNS, Alan, Robert** [AU/AU]; 34 Bay View Terrace, Mosman Park, W.A. 6012 (AU).

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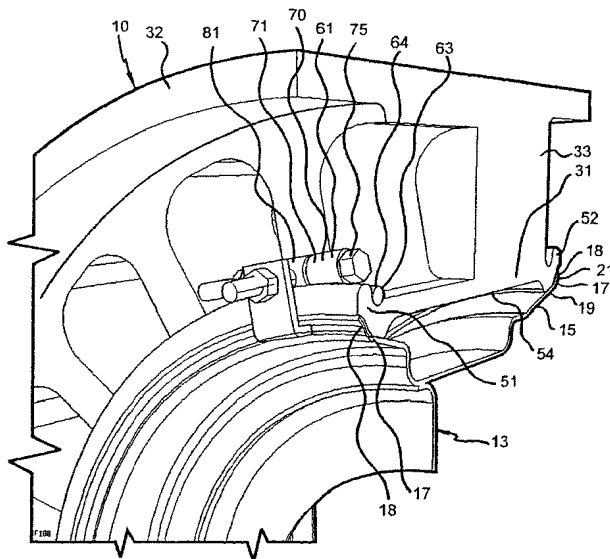
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(74) Agent: **WRAY & ASSOCIATES**; 239 Adelaide Terrace, Perth, W.A. 6000 (AU).

(54) Title: **TYRE CLAMPED TO WHEEL RIM**



(57) Abstract: To secure non-pneumatic tyre (10), radially inner portion (31) thereof is radially contracted onto wheel rim (13). Inner portion (31) may comprise channelled flanges (51-52) on opposed sides of tyre (10). Rings (61) are seated in the channels of flanges (51-52). Segments (63) of the rings (61) are joined at bolted connections (70) allowing contraction of rings (61) and thereby clamping of tyre (10) to rim (13). Alternatively the inner portion of the tyre may have vulcanised thereto a broad metal band formed in segments. Gaps between the segments may be drawn together using bolts, or wedges may be used, to clamp the tyre to the wheel.



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Title

TYRE CLAMPED TO WHEEL RIM

Technical Field

This invention relates to a tyre, and more particularly to a tyre having provision
5 for attachment to a wheel rim.

Background of the Invention

A tyre is required to be firmly fitted onto a rim in order to avoid slippage with respect to the rim when under tractive or breaking loads.

- There have been various proposals for securing tyres onto wheel rims.
- 10 Pneumatic tyres typically have tyre beads which incorporate reinforcing wires and which are stretched over a retaining lip on the wheel rim. Split rim structures are also be used. With non-pneumatic tyres, there are various arrangements for fitting tyres onto rims, one of which involves using a split rim having two sections which are bolted together with the tyre clamped therebetween. In another
- 15 arrangement, a non-pneumatic tyre incorporates a steel band at its radially inner end which is pressed onto a rim to provide a so-called "press-on" tyre. In still another arrangement, a non-pneumatic tyre incorporates a radially inner band (made of suitable material such as steel) which is adapted to be bolted or otherwise affixed to a wheel rim.
- 20 Non-pneumatic tyres almost invariably require dedicated wheel rims onto which they can be fitted. This is disadvantageous, as the need to provide dedicated wheel rims limits the appeal of non-pneumatic tyres and increased the cost of fitting them onto vehicles previously fitted with pneumatic tyres. Accordingly, there is a need for a non-pneumatic tyre which can be fitted onto a conventional
- 25 wheel rim designed for a pneumatic tyre.

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The present invention seeks to provide yet another arrangement for fitting a tyre onto a rim, thereby providing a useful choice. Furthermore, the present invention in an embodiment thereof seeks to provide a non-pneumatic tyre which can be fitted onto a conventional wheel rim designed for a pneumatic tyre.

5 Summary of the Invention

According to one aspect of the present invention there is provided a tyre adapted to be fitted onto a wheel rim, the tyre having a radially inner portion engagable with the wheel rim, the radially inner portion comprising a band adapted for radial expansion and contraction between an expanded condition for positioning of the
10 tyre on the wheel rim and removal of the tyre from the wheel rim, and a contracted condition in which the band engages the wheel rim whereby the tyre is supported thereon, the band being movable into the contracted condition under the influence of a contraction means

The contraction means may be integral with the tyre or separate therefrom.

15 The tyre may further comprise a cushioning structure.

The cushioning structure may comprise a body of resiliently flexible material such as rubber. The resiliently flexible nature of the cushioning structure may function to urge the band towards the expanded condition thereof.

In one form of the invention, the band may comprise a first flange on one side of
20 the tyre, the flange having a face for engaging the wheel rim, wherein the contraction means is adapted to engage the flange to cause radial compression thereof for clampingly engaging the wheel rim.

Preferably, the band further comprises a second flange on the other side of the tyre.

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In such an arrangement, the contraction means may comprise a clamping ring structure associated with the, or each, flange and adapted to engage the respective flange.

5 In another form of the invention, the band may have one or more gaps therein for permitting said radial expansion and contraction, the gaps being defined between sections of the band, and the contraction means selectively moves adjacent sections with respect to each other for radial contraction of the band.

10 The contraction means for selectively moving adjacent sections of the band with respect to each other may comprise an engaging means for engaging the sections and drawing them towards each other.

The cushioning structure may have at least one opening therein for accommodating the engaging means. The opening in the cushioning structure may comprise one of a multitude of openings in the body.

15 Each section of the band may be provided with a portion engagable by the engaging means. The portion may comprise a flange. The flange may be formed integrally with the band by forming an out-turned lip on the respective section adjacent the gap.

20 In one arrangement, the engaging means may be adapted to slidably receive the engaging portion whereby sliding movement of the engaging means with respect to the band causes movement of the two sections towards each other.

In another arrangement, the engaging means may comprise one or more adjustable fastening means extending between the two end sections. The fastening means may comprise one or more shafts with nuts threaded thereon.

25 According to a second aspect of the invention, there is provided a tyre adapted to be fitted onto a wheel rim, the tyre having a radially inner portion engagable with the wheel rim, the radially inner portion comprising first and second flanges on opposed sides of the tyre, the flanges each having a face for engaging the wheel

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rim and being adapted to receive a clamping means for clampingly engaging the flanges with the wheel rim.

Each flange may be of continuous construction or it may comprise a plurality of discrete flange sections in circumferentially spaced apart relationship.

- 5 The clamping means may comprise a clamping ring structure adapted to be fitted around the flange and to be contracted to move the flange into clamping engagement with the wheel rim.

Each flange may incorporate a recess adapted to accommodate the clamping ring structure.

- 10 Each flange may incorporate an upstanding rib adjacent the outer edge of the flange, whereby the respective clamping ring structure locates around the flange inwardly of the rib. With this arrangement, the rib may assist in locating the clamping ring structure in position on the flange and may also assist in resisting any lateral movement between the clamping ring structure and the flange.

- 15 The clamping ring structure may further include means for releasably engaging the wheel rim for positively locating the clamping ring structure with respect to the wheel rim.

- 20 The tyre may comprise a body of resiliently deformable construction. With such an arrangement, the resiliently deformable body provides said cushioning structure.

The body may have a plurality of cavities separated by load-supporting walls, each load-supporting wall having a tread bar at or adjacent the radially outer end thereof.

- 25 According to a third aspect of the invention there is provided a tyre according to the second aspect as defined above in combination with a clamping means for clampingly engaging the flanges with the wheel rim.

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According to a fourth aspect of the invention there is provided a combination of tyre and a clamping means for securing the tyre onto a wheel rim, the tyre having a radially inner portion engagable with the wheel rim, the radially inner portion comprising first and second flanges on opposed sides of the tyre, the flanges
5 each having a face for engaging the wheel rim and being adapted to receive the clamping means for clampingly engaging the flanges with the wheel rim.

With such a combination, the clamping means may comprise two clamping ring structures one corresponding to each flange, each clamping ring structure having means for moving the clamping ring structure between radially expanded and
10 contracted conditions, and means for releasably engaging the wheel rim for positively locating the clamping rim structure with respect to the wheel rim.

According to a fifth aspect of the invention there is provided a clamping means comprising a clamping ring structure having means for moving the clamping ring structure between radially expanded and contracted conditions, and means for
15 releasably engaging a wheel rim for positively locating the clamping rim structure with respect to the wheel rim.

Brief Description of the Drawings

The invention will be better understood by reference to the following description of several specific embodiments thereof as shown in the accompanying drawings
20 in which:

Figure 1 is a perspective view of a tyre according to a first embodiment of the invention;

Figure 2 is a side view of the tyre of Figure 1;

Figure 3 is an end view of the tyre of Figure 1;

25 Figure 4 is a perspective cross-sectional view of the tyre of Figure 1;

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Figure 5 is a perspective view of the tyre of Figure 1 (without the tread structure being shown) fitted onto a wheel rim;

Figure 6 is a partly sectioned fragmentary perspective view of the tyre fitted onto the wheel rim;

5 Figure 7 is a further partly sectioned fragmentary perspective view of the tyre fitted onto the wheel rim, showing in particular a clamping rim structure for clamping the tyre on the wheel rim;

Figure 8 is a further fragmentary perspective view of the tyre fitted onto the wheel rim, showing in particular one form of rim-securing means;

10 Figure 9 is a fragmentary perspective view of the tyre fitted onto the wheel rim utilising an alternative form of rim-securing means;

Figure 10 is a further fragmentary perspective view of the tyre fitted onto a wheel rim using an alternative form of clamping ring structure;

15 Figure 11 is a schematic exploded view of a tyre according to the second embodiment and a rim onto which the tyre is adapted to be fitted;

Figure 12 is a fragmentary perspective view of a band forming part of the tyre according to the second embodiment;

Figure 13 is a side view of Figure 12;

Figure 14 is a plan view of Figure 12;

20 Figure 15 is a schematic exploded view of a tyre according to a third embodiment and a rim onto which the tyre is adapted to be fitted;

Figure 16 is a fragmentary perspective view of a band forming part of the tyre of Figure 15;

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Figure 17 is a side view of Figure 16;

Figure 18 is a plan view of Figure 16;

Figure 19 is a schematic exploded view of a tyre according to a fourth embodiment and a rim onto which the tyre is adapted to be fitted;

5 Figure 20 is a fragmentary perspective view of a band forming part of the tyre of Figure 19;

Figure 21 is a side view of Figure 19;

Figure 22 is a plan view of Figure 20;

10 Figure 23 is a schematic exploded view of a tyre according to a fifth embodiment and a rim onto which the tyre is adapted to be fitted;

Figure 24 is a fragmentary schematic view of a band forming part of the tyre according to the fifth embodiment, the band being shown fitted onto a wheel rim;

15 Figure 25 is a schematic fragmentary side view of the band of the tyre according to the fifth embodiment;

Figure 26 is a cross-sectional view of Figure 24;

Figure 27 is a fragmentary plan view of the band;

Figure 28 is a schematic exploded view of a tyre according to a sixth embodiment and a rim onto which the tyre is adapted to be fitted;

20 Figure 29 is a fragmentary schematic view of a band forming part of the tyre according to the sixth embodiment, the band being shown fitted onto a wheel rim;

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Figure 30 is a schematic fragmentary side view of the band of the tyre according to the sixth embodiment;

Figure 31 is a cross-sectional view of Figure 30;

Figure 32 is a fragmentary plan view of the band;

- 5 Figure 33 is a schematic exploded view of a tyre according to a seventh embodiment and a rim onto which the tyre is adapted to be fitted;

Figure 34 is a fragmentary schematic view of a band forming part of the tyre according to the seventh embodiment, the band being shown fitted onto a wheel rim;

- 10 Figure 35 is a schematic fragmentary side view of the band of the tyre according to the seventh embodiment;

Figure 36 is a cross-sectional view of Figure 35;

Figure 37 is a fragmentary plan view of the band;

- 15 Figure 38 is a schematic exploded view of a tyre according to an eighth embodiment and a rim onto which the tyre is adapted to be fitted;

Figure 39 is a fragmentary schematic view of a band forming part of the tyre according to the eighth embodiment, the band being shown fitted onto a wheel rim;

- 20 Figure 40 is a schematic fragmentary side view of the band of the tyre according to the eighth embodiment;

Figure 41 is a fragmentary plan view of the band;

Figure 42 is a schematic exploded view of a tyre according to a ninth embodiment and a rim onto which the tyre is adapted to be fitted;

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Figure 43 is a fragmentary schematic view of a band forming part of the tyre according to the ninth embodiment, the band being shown fitted onto a wheel rim;

5 Figure 44 is a schematic fragmentary side view of the band of the tyre according to the ninth embodiment;

Figure 45 is a fragmentary plan view of the band;

Figure 46 is a schematic perspective view, in partial section, of a tyre according to a tenth embodiment;

10 Figure 47 is a further schematic perspective view, also in partial section, of the tyre of Figure 46;

Figure 48 is a fragmentary view of a section of the tyre of Figure 46;

Figure 49 is a fragmentary perspective view of a band forming part of the tyre of Figure 46;

Best Mode(s) for Carrying out the Invention

15 Referring now to Figures 1 to 8 of the accompanying drawings, there is shown a non-pneumatic tyre 10 according to a first embodiment. The tyre 10 is adapted to be fitted onto a conventional wheel rim 13 having a rim support surface 15 incorporating a seat 17 on each side of the rim adjacent the rim edge 18. Each seat 17 comprises an inner seat portion 19 and an outer seat portion 21. The
20 inner seat portion 19 is inclined inwardly towards the axis of rotation of the wheel rim, and the outer seat portion 21 is upstanding with respect to the inner seat portion. As mentioned, the wheel rim 13 is of conventional construction and is designed to accommodate a pneumatic tyre. It is a particular feature of the tyre 10 according to this embodiment that it can be fitted onto a standard rim for
25 pneumatic tyres and does not require a dedicated rim structure as is typically the case for previously known non-pneumatic tyres.

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The tyre 10 comprises an annular body 30 having a radially inner portion 31, a radially outer portion 32 incorporating a tread structure 40, and an intermediate portion 33 extending between the radially inner and outer portions to provide cushioning. The tread structure 40 is shown in Figs 1 to 3 but has been omitted
5 from Figs 4 to 8. The tyre 10 also has a central opening 34 and opposed sides 36. The intermediate portion 33 comprises a multitude of holes 35 opening onto opposed sides of the tyre. The holes 35 opening onto one side of the tyre are circumferentially offset from the holes opening onto the other side of the tyre. The holes 35 do not extend entirely through the body 30 and so holes opening
10 on to one side of the tyre are separated from holes opening onto the other side of the tyre by a central circumferential load supporting wall 37. Holes 35 on the same side of the tyre are separated by load supporting walls 39. The load supporting walls 37, 39 extend radially with respect to the tyre and flex under load to provide cushioning. The walls 37, 39 at their radially outer ends support
15 the outer portion 32 and in particular tread bars 41 which are formed integrally with the outer portion 32 and which form the tread structure 40. The tread bars 41 include a central tread bar portion 43 aligned with, and supported by, the central circumferential load supporting wall 37 and lateral tread bar portions 45 supported by the load supporting walls 39. With this arrangement, the tread bars
20 41 form part of the structure of the tyre.

The radially inner portion 31 of the tyre defines a band 50 which is formed integrally therewith. The band 50 comprises first and second flanges 51, 52 provided on opposed sides of the tyre. Each flange 51, 52 is configured to define a bead 53 adapted to bear on a respective one of the seats 17 formed on
25 the wheel rim 13. The beads 53 each present an inner face 55 for engagement with the respective seat 17.

Each flange 51, 52 incorporates a circumferential recess 57 on the radially outer side thereof. An upstanding rib 59 is provided on the outer edge of each flange 51, 52 adjacent the recess 57.

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A contraction means 60 is provided for radially contracting the flanges 51, 52 inwardly thereby to cause clamping engagement between each bead and the respective seat.

5 The contraction means 60 is in the form of two clamping ring structures 61, one for each flange 51, 52. Although only one clamping ring structure 61 is shown in position in Figure 6, clamping ring structures 61 are in fact fitted onto both flanges 51, 52.

10 Each clamping ring structure 61 comprises a plurality of clamping ring sections 63, there being two such ring sections 63 in this embodiment. The clamping ring sections 63 are connected in end-to-end relationship to form the assembled clamping ring structure 61 by connector means 70. The connector means 70 are adapted to draw adjacent ends of the ring clamping sections 63 together to effect contraction of the clamping ring structure 61.

15 In this embodiment, the connector means 70 comprises connector sleeves 71 provided on the ends of each clamping ring section 63. With this arrangement, the connector sleeves 71 at adjacent ends of neighbouring clamping ring sections 63 align to receive a clamping bolt assembly 75 comprising a bolt 77 and a nut 79. Threaded engagement between the nut and bolt assembly 75 serves to draw the ends of the clamping ring section 63 together thereby to
20 radially contract the clamping ring structure 61.

In this embodiment, each clamping ring section 63 comprises a length of rod 64 with connector sleeves 71 at the ends thereof. The rod 64 is curved along its length to conform generally to the curvature of the flange 51, 52. In this embodiment, the rod 64 is of circular cross-section and the recess 57 is of a
25 curved profile in cross-section to conform to the rod.

A rim-engaging means 80 is associated with each connector means 70 for the purpose of physically securing the clamping ring structure 60 to the rim 13 thereby resisting rotation of the clamping ring structure around the wheel rim.

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The rim-engaging means 80 comprises an intermediate sleeve 81 located between the two connector sleeves 71 of each connector means 70. The intermediate sleeve 81 is aligned with the connector sleeves 71 so as to also receive the bolt 77. The intermediate sleeve 81 supports a threaded shaft 83 on
5 which a rim-engaging element 85 is mounted. The rim-engaging element 85 comprises an inner portion 87 incorporating a mounting hole (not shown) through which the threaded shaft 83 is received, and an outer portion 89 which defines a lip for contacting the outer side of the wheel rim 13 adjacent its edge 18. A nut 91 is threadedly engaged with the shaft 83 for securing the rim-engaging
10 member 85 in position.

As previously mentioned, the tyre 10 according to this embodiment has been devised for installation on a conventional wheel rim 13. To fit the tyre 10 onto the wheel rim 13, the tyre is positioned on the wheel rim 13 such that the beads 53 defined on the flanges 51, 52 are aligned with the seats 17 on the wheel rim 13.
15 The central opening 34 within the tyre 10 may be of a size such that the tyre can be manually fitted onto the wheel rim 13, or alternatively means may be required to press or otherwise urge the tyre into position on the wheel rim 13. Once the tyre 10 is in position on the wheel rim 13, the clamping ring structures 61 are positioned around the flanges 51, 52. The connectors 70 are then progressively
20 tightened in order to contract the clamping ring structures 61 so as to clampingly engage the flanges 51, 52 against the wheel rim. The rim-engaging means 80 are then tightened so as to physically secure the clamping band structures 61 to the rim 13.

The upstanding rib 59 on each flange 51, 52 serves to resist any tendency for the
25 respective flange 51, 52 to slip under the clamping ring structure 61 during use.

It has been found that the tyre 10 according to the present embodiment, when clamped onto a conventional wheel rim, performs particularly well in use and without slippage when under tractive and breaking loads.

Referring now to Figure 9, there is shown an alternative clamping ring structure
30 61 for clamping the tyre 10 onto the wheel rim 13. Such a clamping ring

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structure 61 comprises clamping ring sections 63 and connectors 70 connecting the clamping ring sections 63 in end-to-end relationship, as the case previously. Each connector means 70 comprises connector sleeves 71 on the ends of the clamping ring sections 63 and a bolt assembly 75 for securing the clamping ring sections together. In this arrangement, each rim-clamping means 80 comprises a clip 92 having a first end 93 for engaging the wheel rim 13 and a second end 94 for engaging a section 95 of the shank of the bolt 77 extending between the two connector sleeves 71. The end 94 is configured as an open sleeve defining a hook which engages over the bolt.

10 With this arrangement, the rim-engaging means 80 is installed loosely in position prior to contraction of the clamping ring structure 61, with the end 93 engaging against the wheel rim 13 and the end 94 hooked over the shank of the bolt 77. As the clamping band structure 61 is tightened to clampingly engage the respective flange 51, 52, the progressive contraction of the clamping ring structure causes it to slide laterally down the inclined inner seat portion 19 of the seat 17 of the wheel rim 13 thereby tensioning the clip 92 and securing the clamping ring structure 61 to the wheel rim 13.

With the tyre 10 clamped onto the wheel rim by way of the two flanges 51, 52, the section 54 of the radially inner portion 31 between the two flanges is suspended in position between the two flanges. Because of the configuration of the wheel rim 13, the section 54 does not contact, and so is not supported by, the wheel rim. Because the section 54 is in a suspended condition, it can flex and so provide further cushioning for the tyre.

25 If desired, cushioning material can be fitted between the section 54 of the tyre and the wheel rim for the purpose of further controlling the cushioning characteristics of the tyre. The cushioning material may comprise a length of flexible material (such as flexible polyethylene pipe) wrapped around the rim.

In the arrangements previously described, each clamping ring structure 61 was formed of clamping ring sections 63 formed of rod 64 of circular cross-section. It should be appreciated that clamping ring section 63 of other configurations are

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possible. For example, the clamping ring sections can be formed of bar 64 of rectangular cross section, as illustrated in Figure 10.

Referring to Figures 11 to 14 of the accompanying drawings, the tyre 111 according to a second embodiment is adapted to be fitted onto a rim 113 having
5 a circumferential support surface 115 and two flanges 117 one to each side of the support surface 15, as shown in Figure 11 of the drawings.

The tyre 111 comprises a radially inner portion 121 and a radially outer portion 122.

The radially inner portion 121 comprises a band 123 formed of robust material
10 such as steel. The band 123 is of generally annular construction having two opposed sides 125 and an axial split 127 formed therein extending between the two opposed sides 125. The axial split 127 defines a gap 129 for permitting radial expansion and contraction of the band, as will be explained in more detail.

The band 123 has two end sections 131, 132 on opposed sides of the gap 129,
15 the two sections being formed integrally with the band.

Each end section 131, 132 is formed with an engaging portion 133 of angular cross-section. Each engaging portion 133 includes a first web 135 projecting radially from the respective end section 131, 132, and a second web 137 at the outer end of the first web.

20 Engaging means 141 in the form of two shafts 143 having nuts 145 threaded onto the ends thereof are provided between the engaging portions 133. Each nut 145 is accommodated in the cavity 146 defined between the band 125 and the angular engaging portions, as best seen in Figure 12 of the drawings.

By tightening the nuts 145 onto the threaded shafts 143, the two end sections
25 131, 132 of the band can be drawn together, thereby radially contracting the band 123.

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The radially outer portion 122 of the tyre comprises a body 151 of resiliently flexible material such as rubber. The body incorporates a multitude of holes 153 positioned at spaced intervals throughout the body, the holes extending cross-wise through the body between end faces 155 thereof. One of the holes
5 153 aligns with the gap 129 in the band 123 so that the end sections 131, 132 and the engaging means 141 are accessible through that opening 153.

In use, the nuts 145 are unwound from the threaded shaft 143 to an extent which allows radial expansion of the band 125 to an extent to allow the tyre 111 to pass over one of the flanges 117 on the rim 113 and be positioned in alignment with
10 the circumferential support surface 115. The nuts 145 are then tightened so as to close the gap 129 and thereby radially contract the band 123 into clamping engagement with the surface 115. In this way, the tyre 111 is securely fitted onto the rim 113.

Referring now to Figures 15 to 18 of the accompanying drawings, the tyre
15 according to the third embodiment is similar to that of the second embodiment with the exception that the engaging portions 133 each simply comprise an out-turned flange 161. The engaging means 141 in this embodiment comprises the threaded shafts 143 and associated nuts 145, together with an angular element 163 which is positioned on the two flanges 161. The angular element 167 has a
20 first web 165 which bears against one of the flanges and a second web 163 which bridges the two flanges.

Referring now to Figures 19 to 22, the tyre according to the fourth embodiment is similar to the third embodiment, with the exception that the two flanges 161 are simply connected together by engaging means 141 in the form of bolts 143 and
25 nuts 145. The two bolts 143 are positioned in opposite directions, as best seen in Figure 20.

Referring now to Figures 23 to 27 of the accompanying drawings, the tyre 111 according to the fifth embodiment comprises a radially inner portion 121 and a radially outer portion 122, as was the case with the earlier embodiments. The
30 radially inner portion 121 defines a band 123 which incorporates a gap 129 with

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engaging portions 133 formed integrally with the band 123 on opposed sides of the gap 129. The engaging portions 133 each comprise two lips 171, 172 formed integrally with the band. The two lips 171, 172 on each side of the gap are both inclined with respect to the axial direction of the band, but the direction
5 of inclination is in opposite directions, as best seen in Figure 23 of the drawings. In this way, the lip 171 on end section 131 co-operates with the lip 171 on the other end section 132 to define a V-formation 173. Similarly, the lip 172 on end section 131 co-operates with the lip 172 on end section 132 to define a further V-formation 174.

10 The engaging means 141 in this embodiment comprises two clamping blocks 175, 176, one adapted to engage one V-formation and the other adapted to engage the further V-formation 174.

Each clamping block 175, 176 incorporates a pair of angularly disposed channels 177 which receives the respective V-formations 173, 174. such that by
15 movement of the clamping blocks 175, 176 towards each other causes closing of the gap 129. A connection element 178 extends between the clamping blocks 175, 176 whereby rotation of the connection element causes movement of the clamping blocks 175, 176 towards or away from each other as the case may be. Each end of the connection element 178 incorporates a recess 179 for receiving
20 a tool for rotating the connection element.

The embodiment shown in Figures 28 to 32 of the accompanying drawings is similar to the previous embodiment with the exception that one of the engaging portions 133 presents a planar face 181 and the other engaging portion 133 presents inclined face 183. The clamping blocks 175, 176 are appropriately
25 configured to operate in a similar fashion to the previous embodiment.

The embodiment shown in Figures 38 to 41 is directed to a tyre 111 incorporating a radially inner portion 121 and a radially outer portion 122. The radially inner portion 121 is defined by a band 123 which incorporates a gap 129. In this embodiment, the end sections 131, 132 on opposed sides of the gap are
30 configured to define interleaved loops 190 which defines a channel formation

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191 for receiving a wedge-shaped locking element 193. The channel 191 defined by the loops 190 tapers between a larger end 194 and a narrower end 195 such that insertion of the wedge-shaped locking element 193 causes the channel 191 to expand and thereby effect radial contraction of the band. The
5 locking element 193 can be inserted into the channel 191 in any suitable fashion, such as by being driven with hammer 197.

The embodiment shown in Figures 42 to 45 of the accompanying drawings is somewhat similar to the previous embodiment with the exception that the locking element 193 is formed in two sections 193a and 193b, connected together by a
10 connecting element 201, and with the further exception that the channel formation 191 is also configured in two tapering sections 191a and 191b. With this arrangement, each section 193a, 193b of the locking element 193 is received in a respective one of the channel sections 191a and 191b. With the locking sections 193a, 193b received in the channel sections 191a, 191b and
15 connected together by the connecting element 201, the two channel sections can be drawn towards each other by rotation of the connecting element thereby to cause expansion of the channel sections and hence radial contraction of the band.

In several embodiments described previously, the radially inner portion 121 of
20 the tyre 111 comprises a band 123 having a single axial split 127 therein to provide the gap 129. In many cases, it is likely that the band 123 would have a plurality of slits 127 provided therein thereby to form the band 123 in a series of band sections each separated by a respective gap 129. One such embodiment is illustrated in Figures 46 to 49 of the drawings. In this embodiment, the band
25 123 comprises a series of band sections 123a each separated by a gap 129. In this embodiment, each band section 123a has flanges 161 on the ends thereof (as best seen in Figure 49), somewhat similar to the arrangement shown in the embodiment of Figures 19 to 22.

In this embodiment, the body 151 providing the radially outer portion 122 of the
30 tyre incorporates a multitude of holes 153 on opposed sides of the tyre. the

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holes 153 on one side of the tyre are separated from the holes on the other side of the tyre by a central circumferential wall 210. Holes on the same side of the tyre are separated by a load supporting walls 211. The load supporting walls 210, 211 extend radially with respect to the tyre and at the radially outer end thereof support tread bars 213 with which they are integrally formed. The tread bars 213 include a central tread bar 213a supported on the wall 210 and lateral tread bars 213b supported on the walls 211.

From the foregoing, it is evident that the present invention provides a simple, yet highly effective, arrangement for securely fitting a tyre onto a wheel rim.

10 It should be appreciated that the scope of the invention is not limited to the scope of the embodiments described.

Throughout the specification, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

The Claims defining the invention are as follows:

1. A tyre adapted to be fitted onto a wheel rim, the tyre having a radially inner portion engagable with the wheel rim, the radially inner portion comprising a band adapted for radial expansion and contraction between an expanded
5 condition for positioning of the tyre on the wheel rim and removal of the tyre from the wheel rim, and a contracted condition in which the band engages the wheel rim whereby the tyre is supported thereon, the band being movable into the contracted condition under the influence of a contraction means
2. A tyre according to claim 1 wherein the band comprises a first flange on one
10 side of the tyre, the flange having a face for engaging the wheel rim, wherein the contraction means is adapted to engage the flange to cause radial compression thereof for clampingly engaging the wheel rim.
3. A tyre according to claim 2 therein the band further comprises a second flange on the other side of the tyre.
- 15 4. A tyre according to claim 1, 2, or 3 in combination with a contraction means comprising a clamping ring structure associated with the, or each, flange and adapted to engage the respective flange.
5. A tyre according to claim 1 wherein the band has one or more gaps therein for permitting said radial expansion and contraction, the gaps being defined
20 between sections of the band, and wherein the contraction means selectively moves adjacent sections with respect to each other for radial contraction of the band.
6. A tyre according to claim 5 in combination contraction means for selectively moving adjacent sections of the band with respect to each other, wherein the
25 contraction means comprises an engaging means for engaging the sections and drawing them towards each other.

- 20 -

7. A tyre according to claim 6 further comprising a cushioning structure having at least one opening therein for accommodating the engaging means.
8. A tyre according to claim 7 wherein the or each opening in the cushioning structure comprises one of a multitude of openings in the body.
- 5 9. A tyre according to claim 6, 7 or 8 wherein each section of the band may be provided with a portion engagable by the engaging means.
10. A tyre adapted to be fitted onto a wheel rim, the tyre having a radially inner portion engagable with the wheel rim, the radially inner portion comprising first and second flanges on opposed sides of the tyre, the flanges each having a face
10 for engaging the wheel rim and being adapted to receive a clamping means for clampingly engaging the flanges with the wheel rim.
11. A tyre according to claim 10 wherein each flange incorporates a recess adapted to accommodate the clamping ring structure.
12. A tyre according to claim 10 or 11 wherein each flange incorporates an
15 upstanding rib adjacent the outer edge of the flange, whereby the respective clamping ring structure locates around the flange inwardly of the rib.
13. A tyre according to claim 10, 11 or 12 in combination with a clamping means for clampingly engaging the flanges with the wheel rim.
- 14 A tyre according to claim 10, 11 or 12 in combination with a clamping means
20 comprising a clamping ring structure adapted to be fitted around each flange and to be contracted to move the flange into clamping engagement with the wheel rim.
- 15 A tyre according to any one of claims 10 to 14 further comprising a body of resiliently deformable construction.

- 21 -

16 A tyre according to claim 15 wherein the body has a plurality of cavities separated by load-supporting walls, each load-supporting wall having a tread bar at or adjacent the radially outer end thereof.

17 A clamping means comprising a clamping ring structure having means for
5 moving the clamping ring structure between radially expanded and contracted conditions, and means for releasably engaging a wheel rim for positively locating the clamping rim structure with respect to the wheel rim.

18 A combination of tyre and a clamping means for securing the tyre onto a wheel rim, the tyre having a radially inner portion engagable with the wheel rim,
10 the radially inner portion comprising first and second flanges on opposed sides of the tyre, the flanges each having a face for engaging the wheel rim and being adapted to receive the clamping means for clampingly engaging the flanges with the wheel rim.

19 The combination of claim 18 wherein the clamping means comprises a
15 clamping ring structure adapted to be fitted around each flange and to be contracted to move the flange into clamping engagement with the wheel rim.

20 The combination of claim 18 wherein the clamping means comprises a clamping ring structure adapted to be fitted around each flange, each clamping ring structure having means for moving the clamping ring structure between
20 radially expanded and contracted conditions, and means for releasably engaging the wheel rim for positively locating the clamping rim structure with respect to the wheel rim.

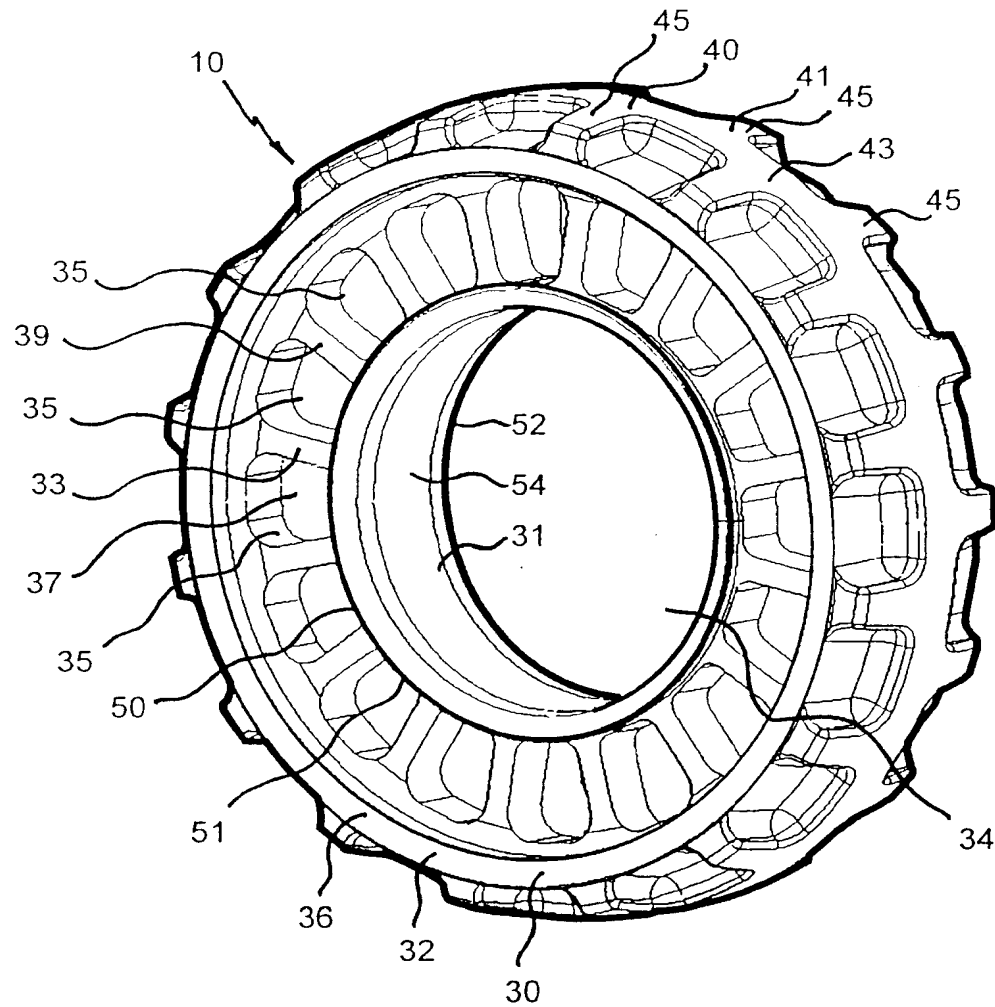
21 A tyre substantially as herein described with reference to the accompanying drawings

22 A combination of a tyre and a clamping means substantially as herein
25 described with reference to the accompanying drawings

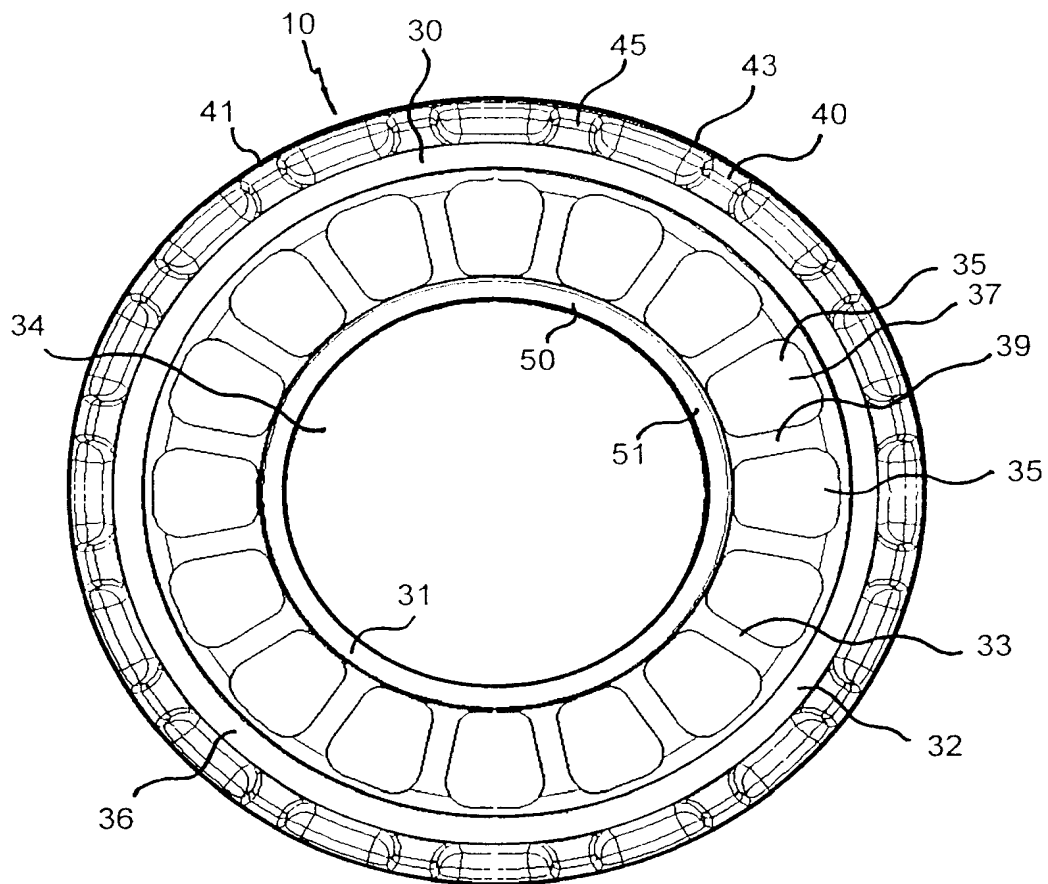
- 22 -

23 A clamping band structure substantially as herein described with reference to the accompanying drawings.

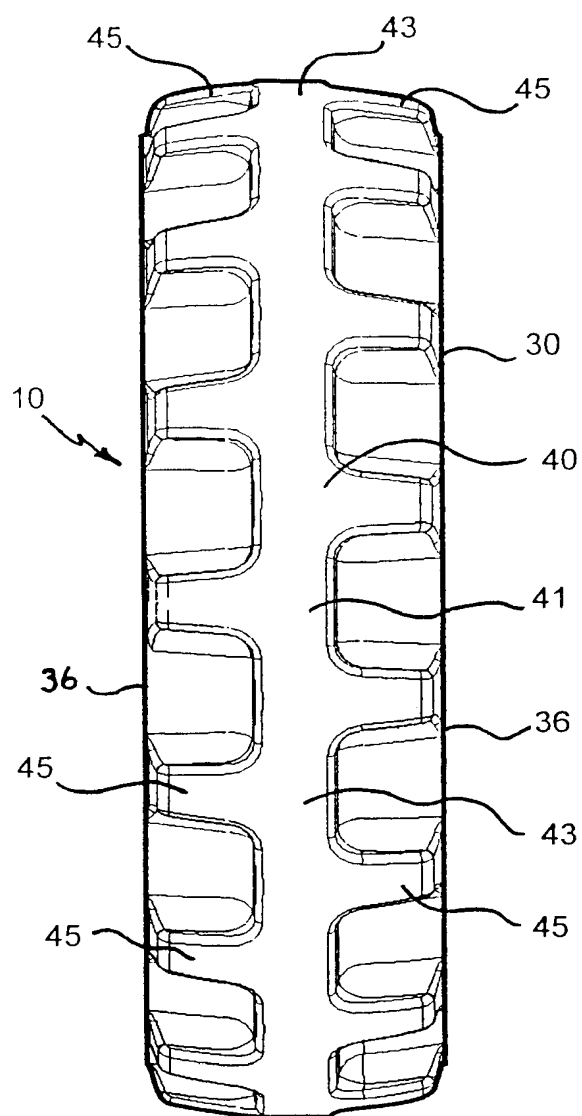
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**Fig. 1**

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**Fig. 2**

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**Fig. 3.**

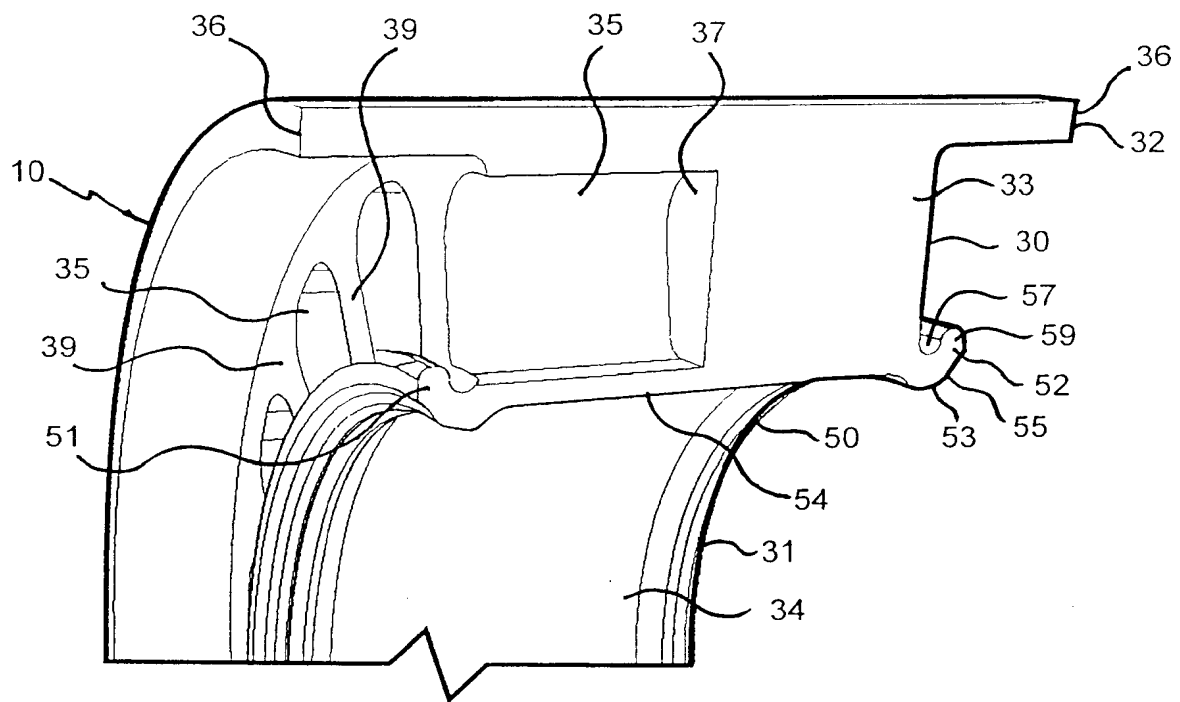
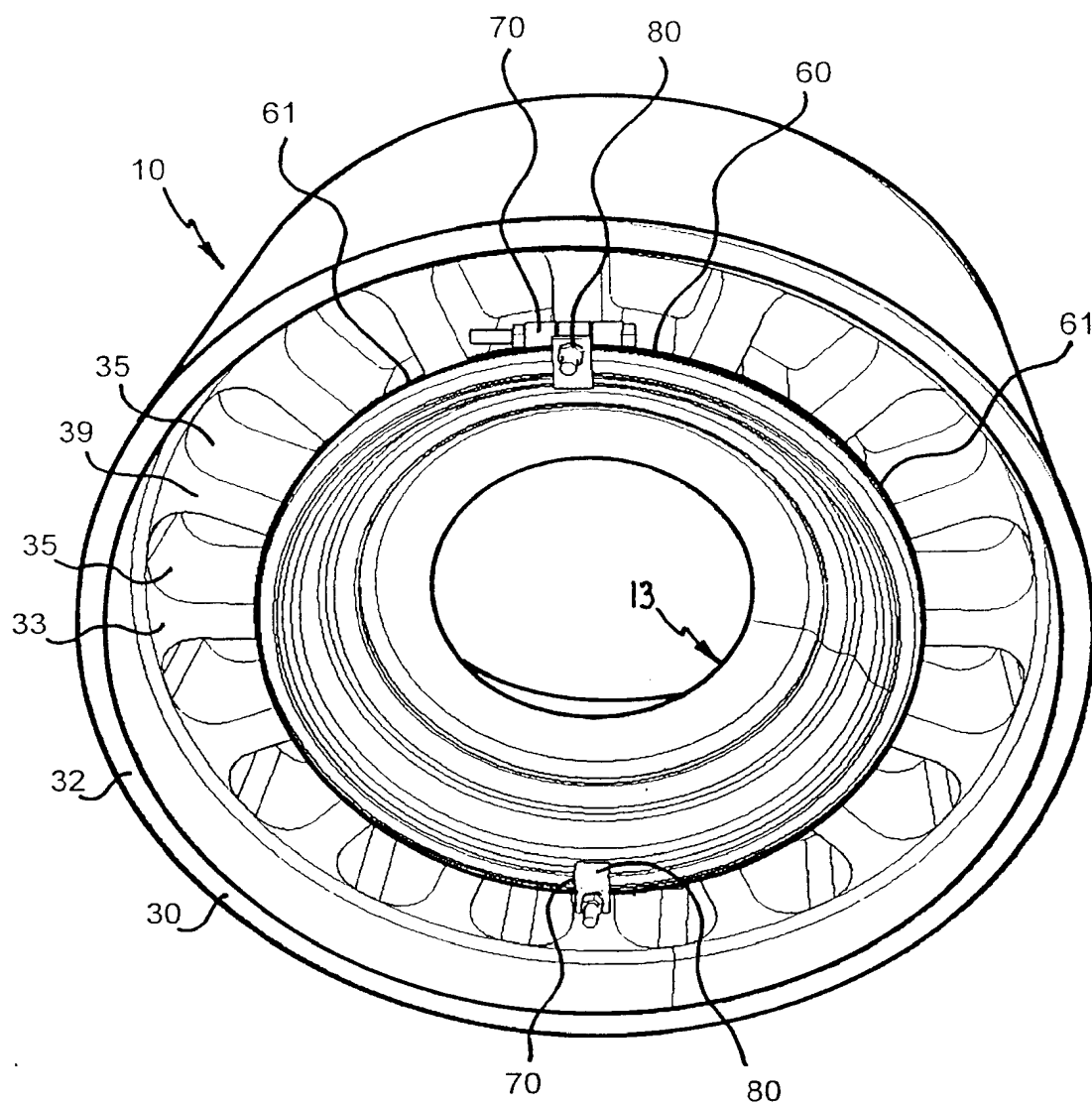
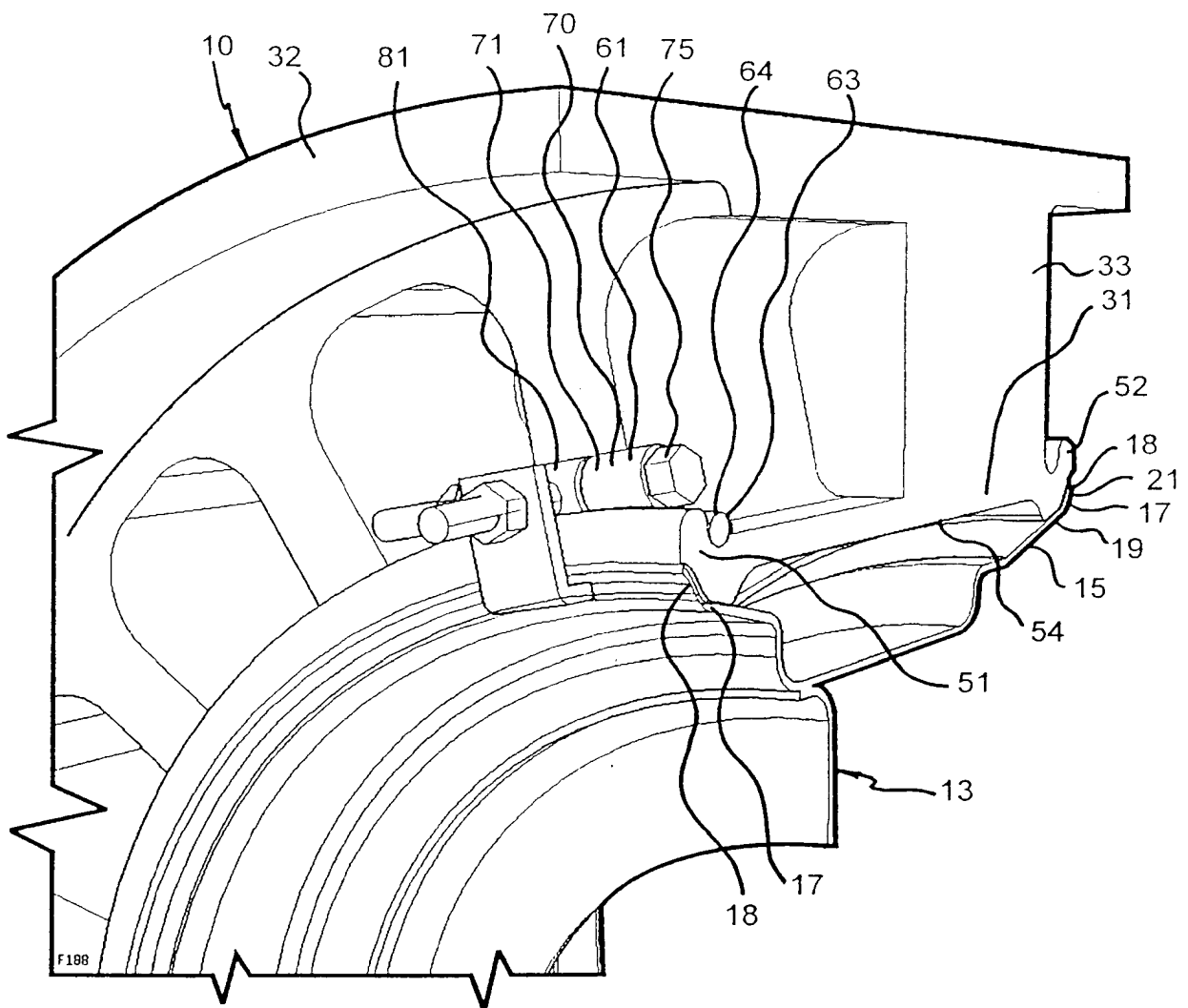


Fig. 4,

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**Fig. 5.**

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**Fig. 6**

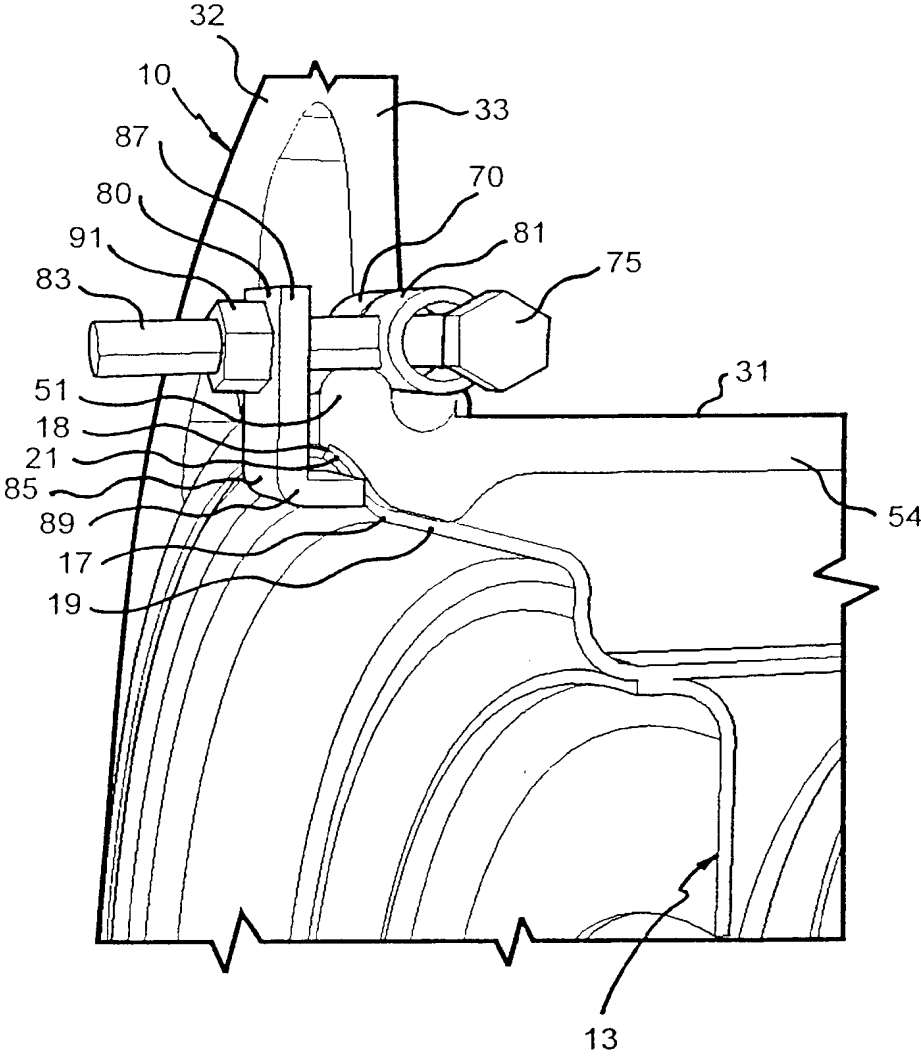


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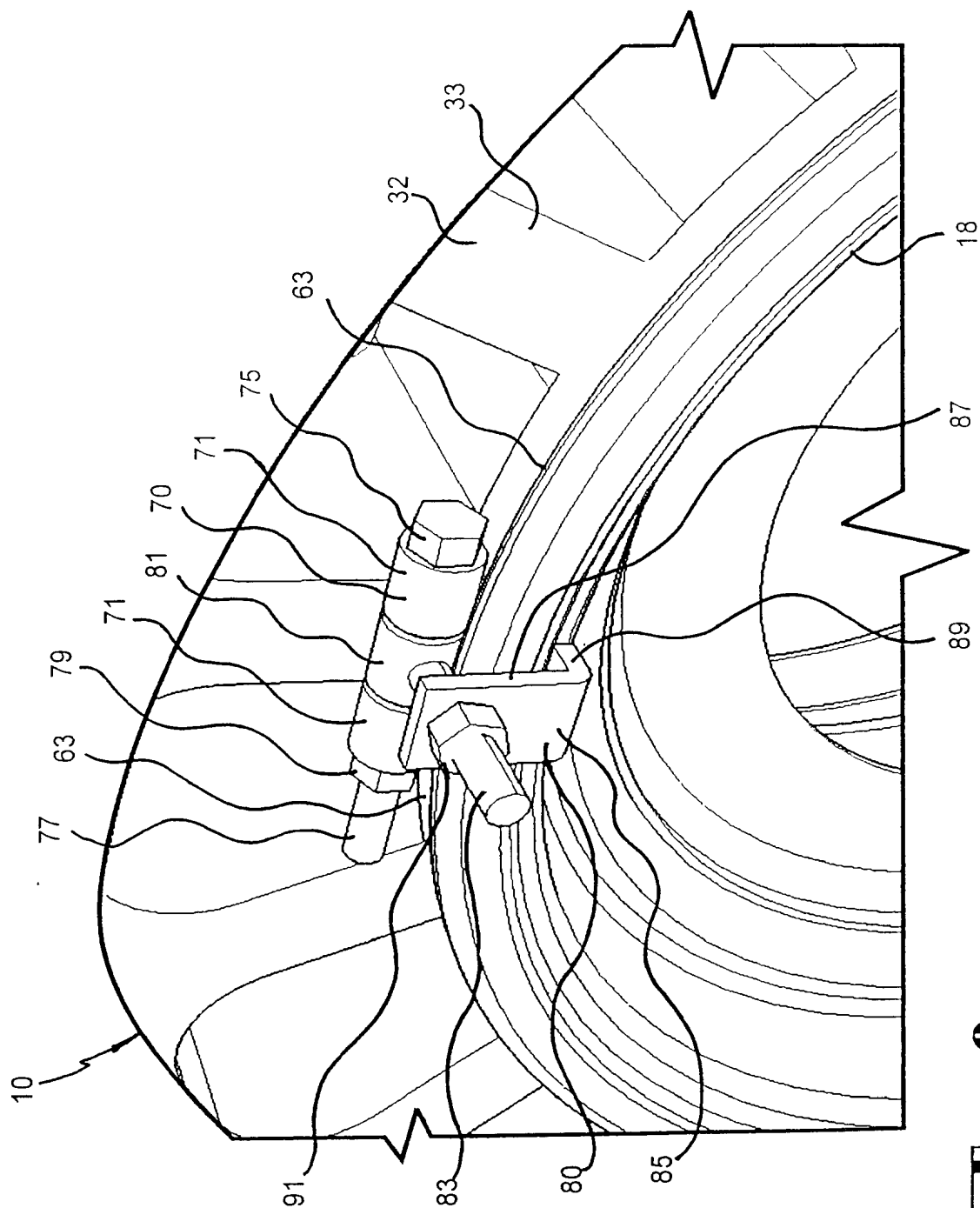


Fig. 8

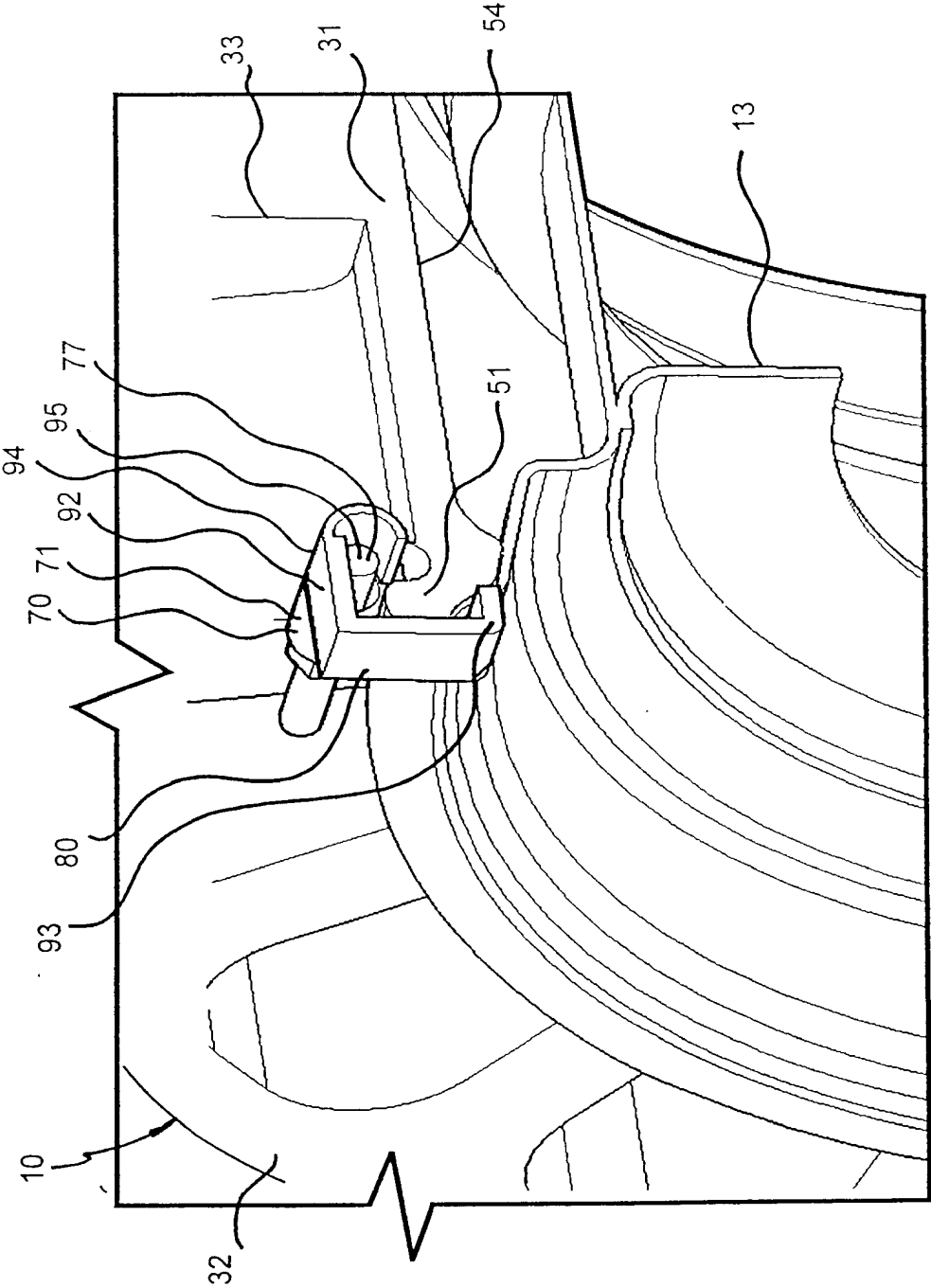


Fig. 9

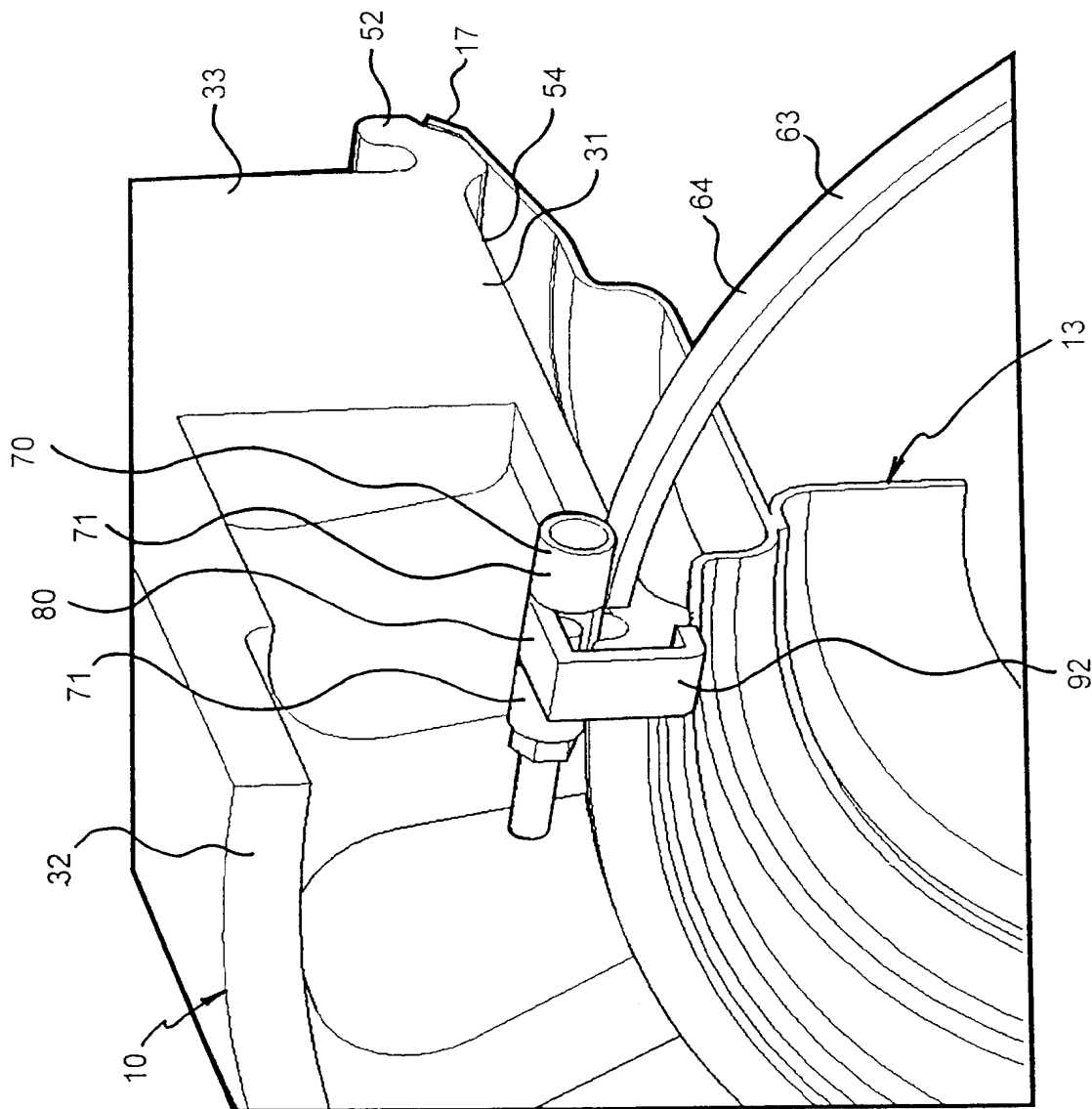


Fig. 10

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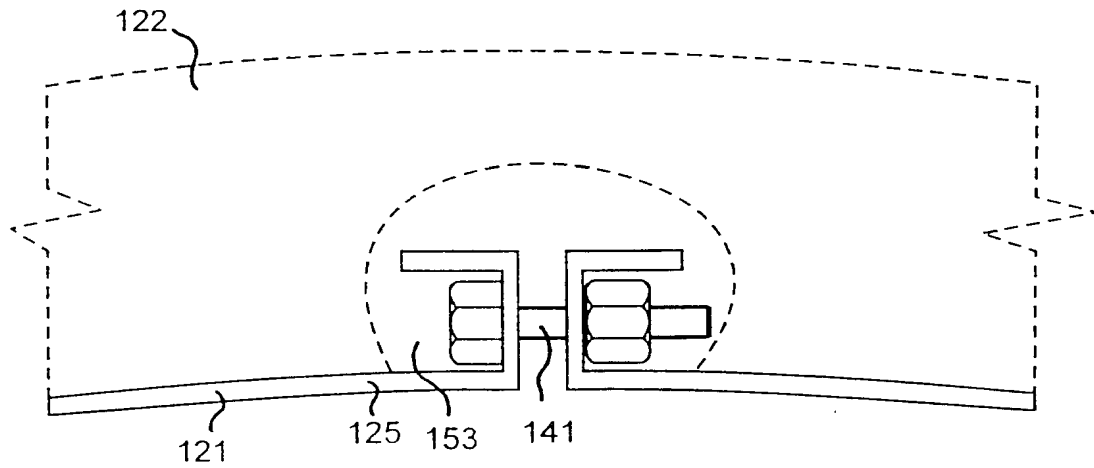


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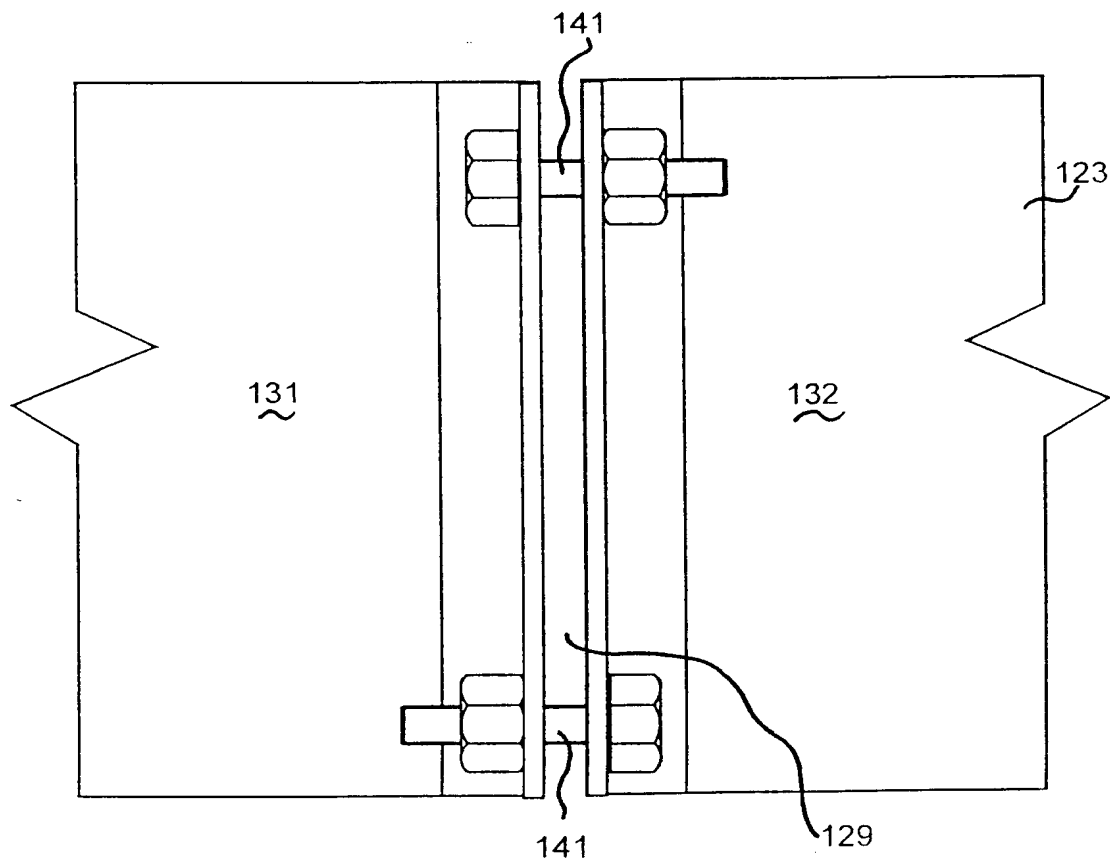


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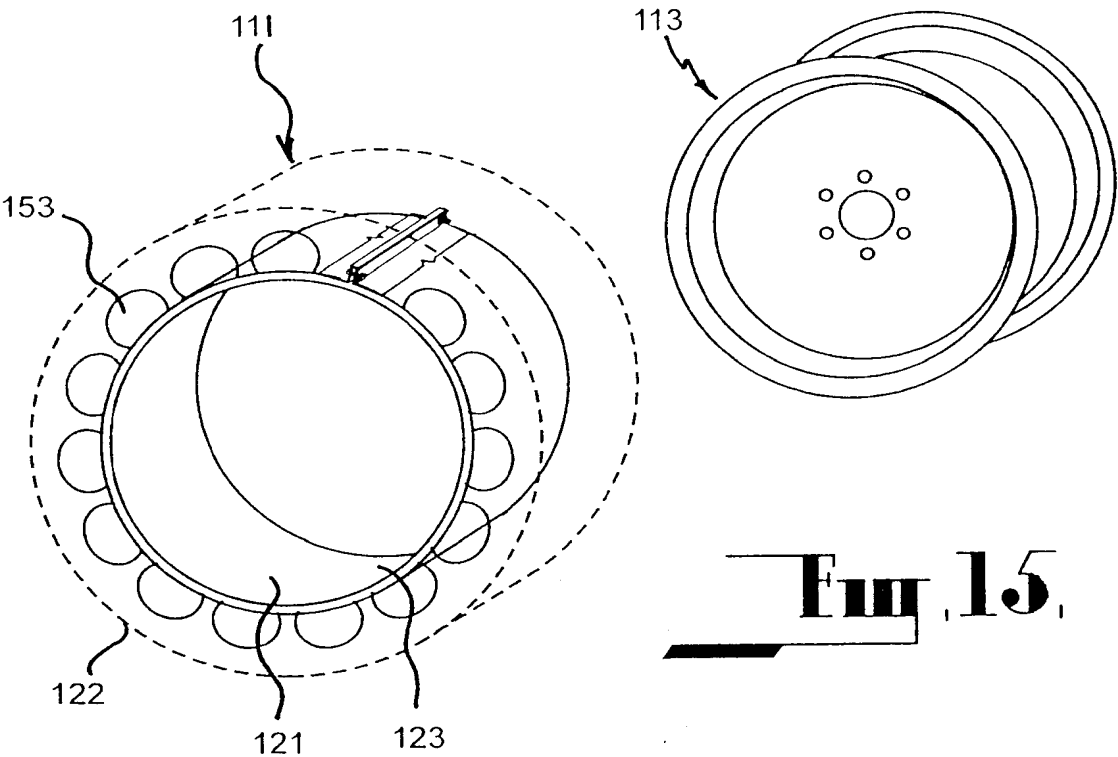


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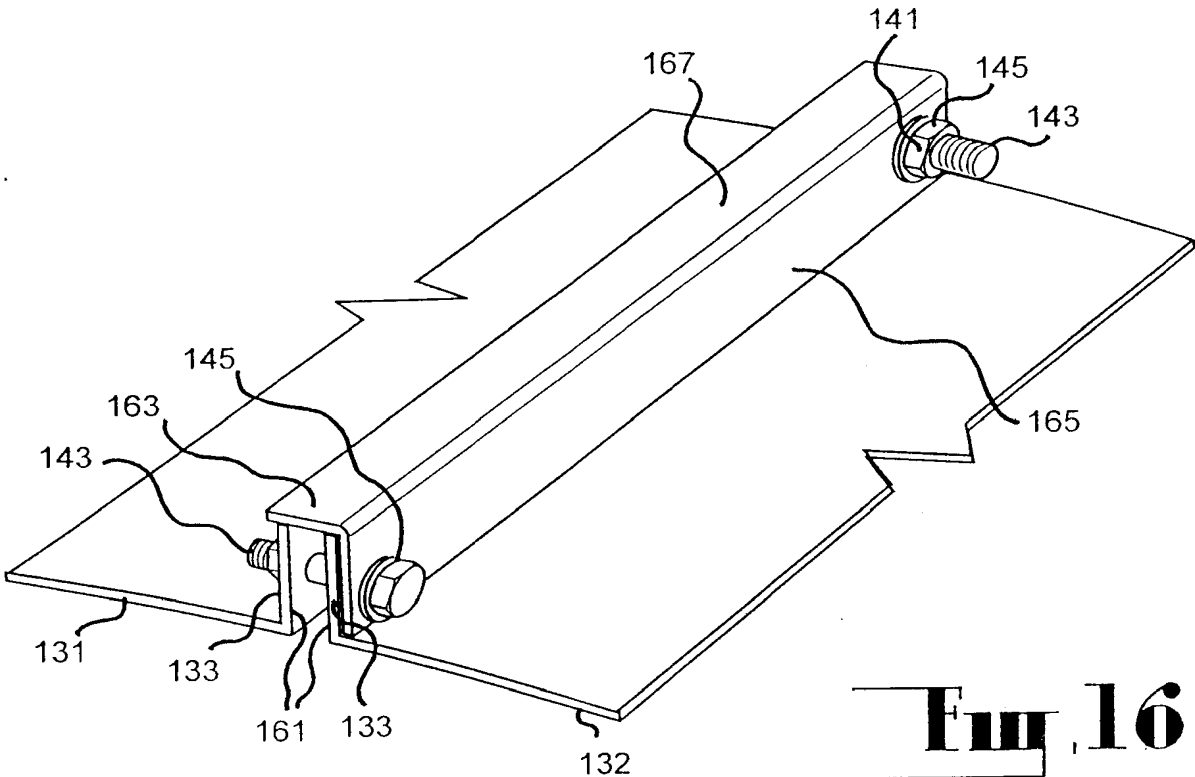


Fig. 16.

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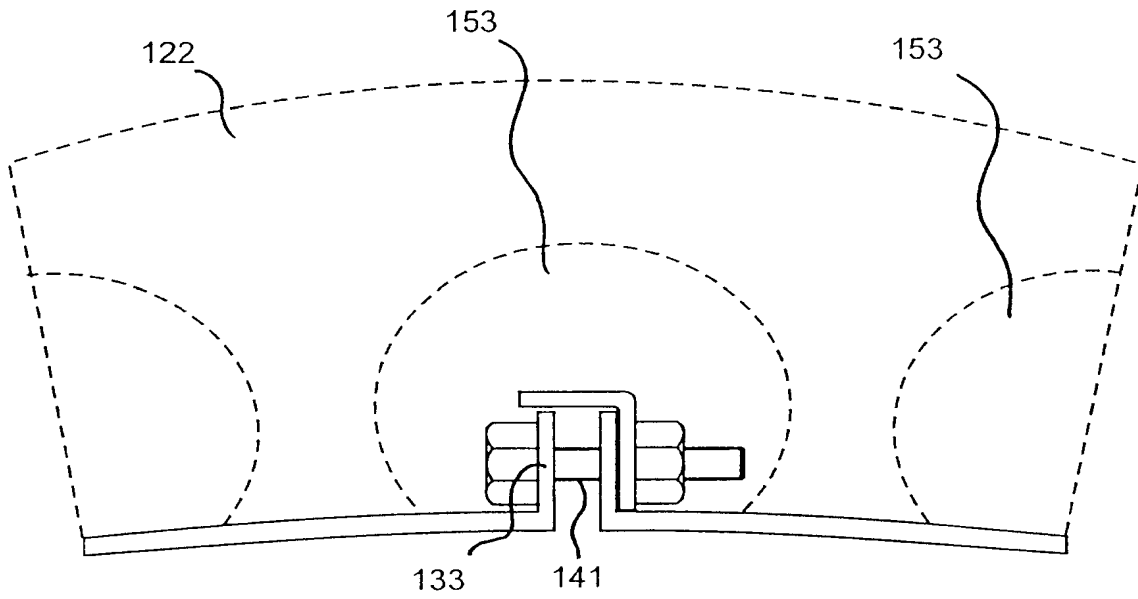


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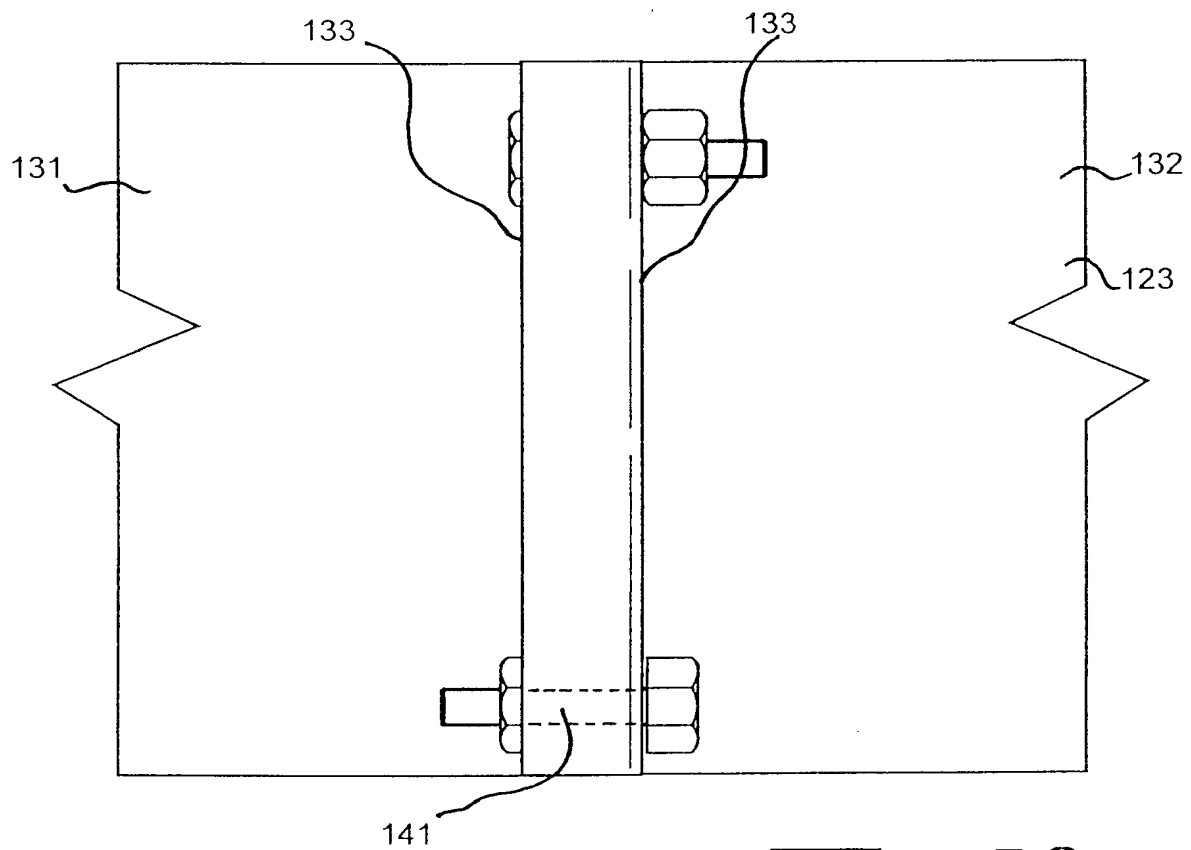


Fig. 18.

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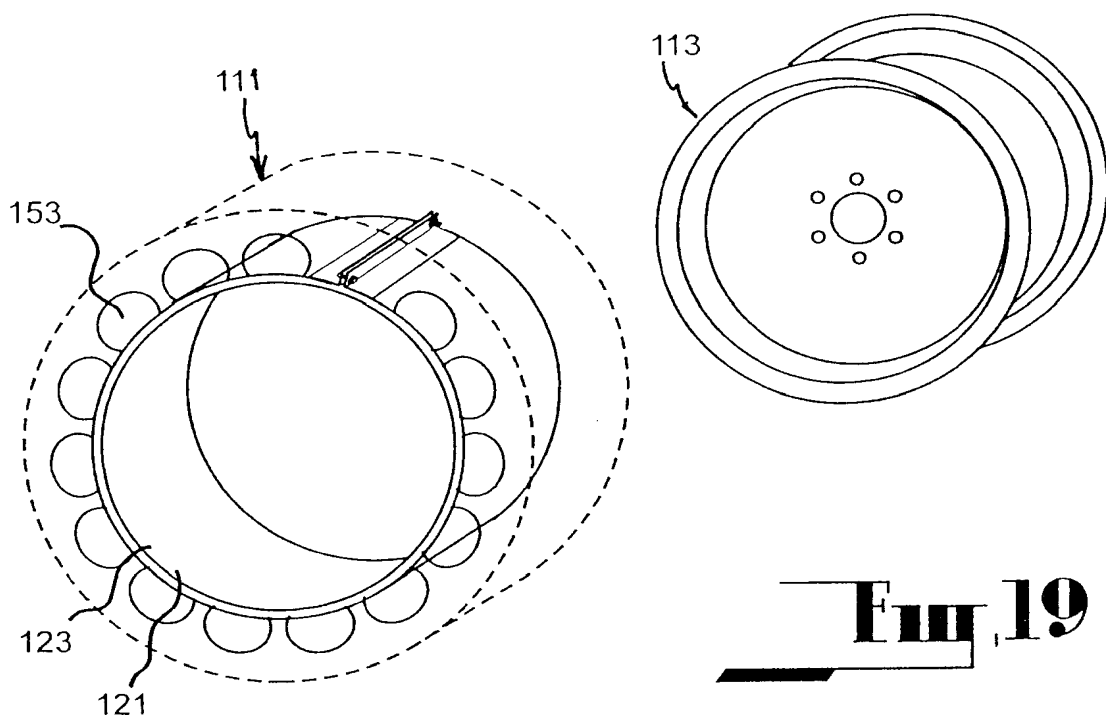


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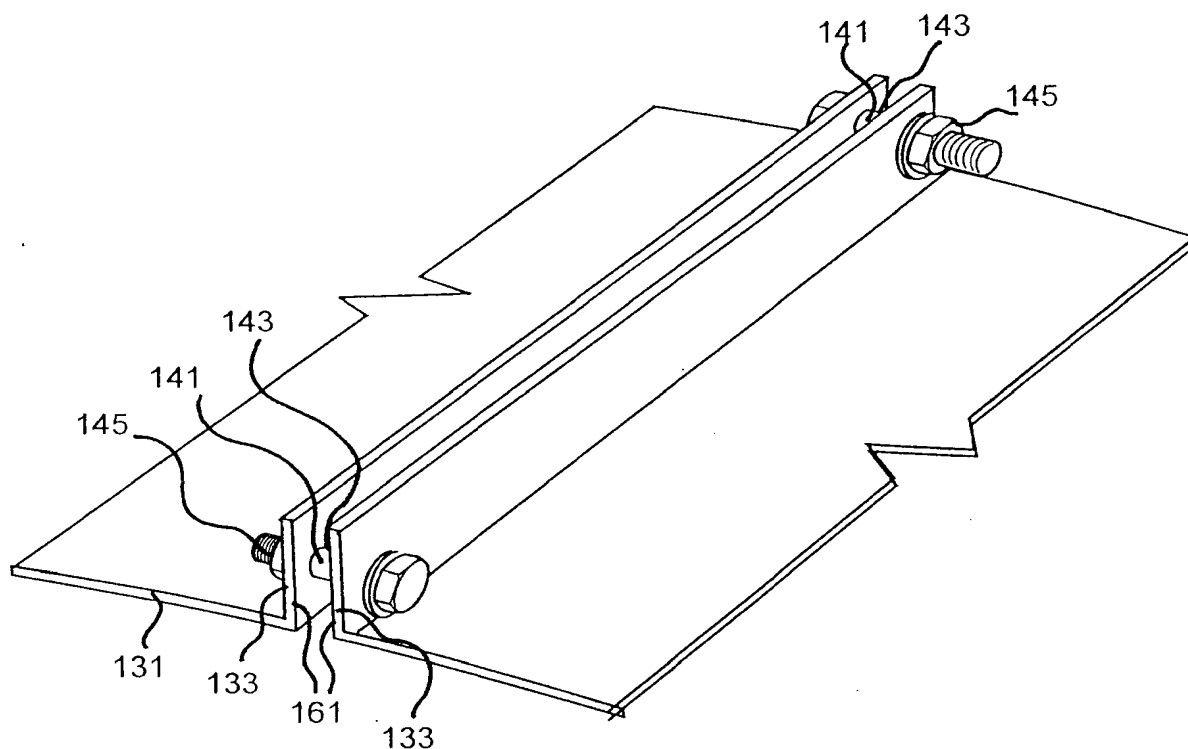


Fig. 20.

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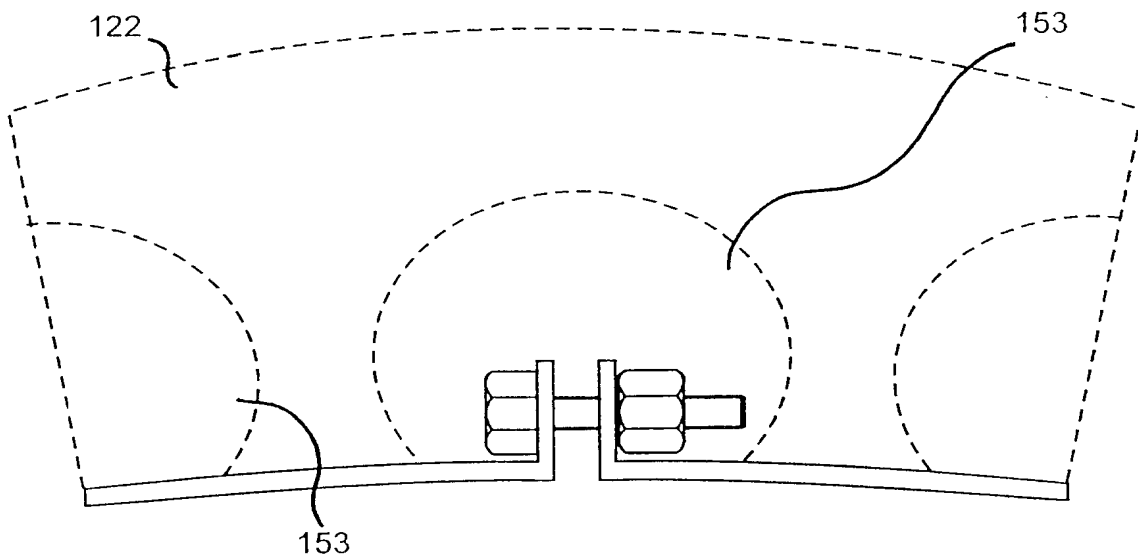


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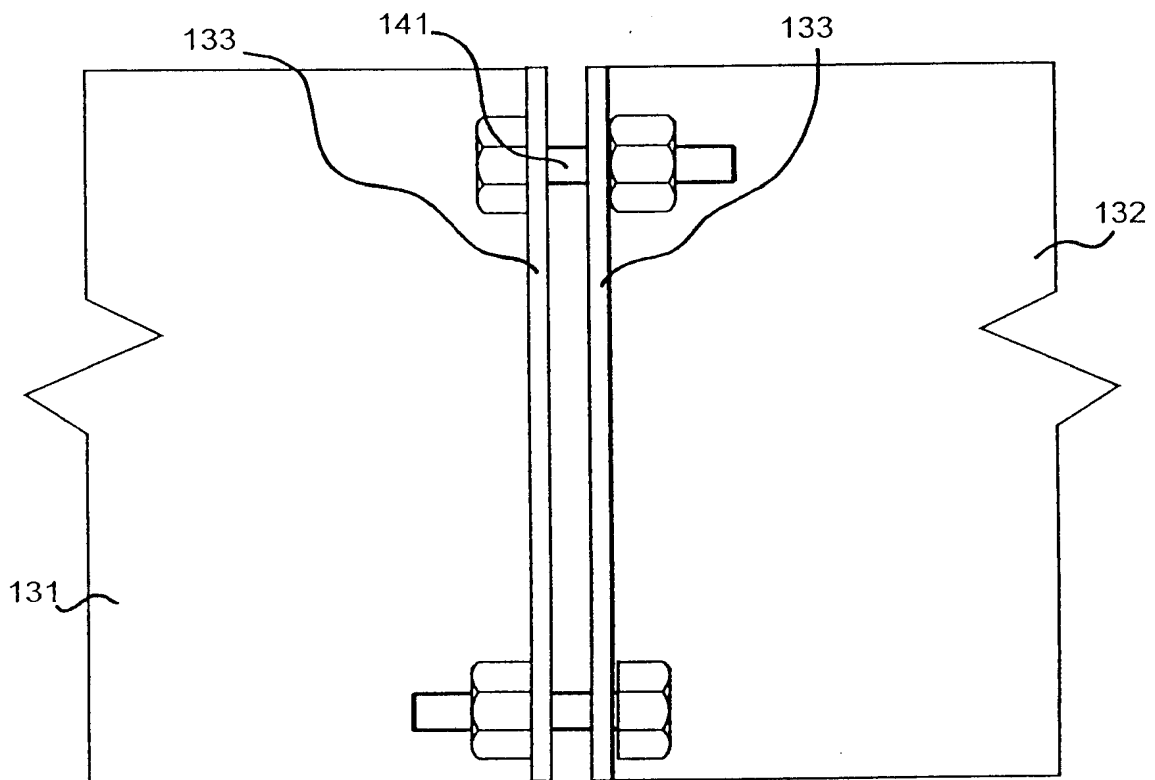


Fig. 22.

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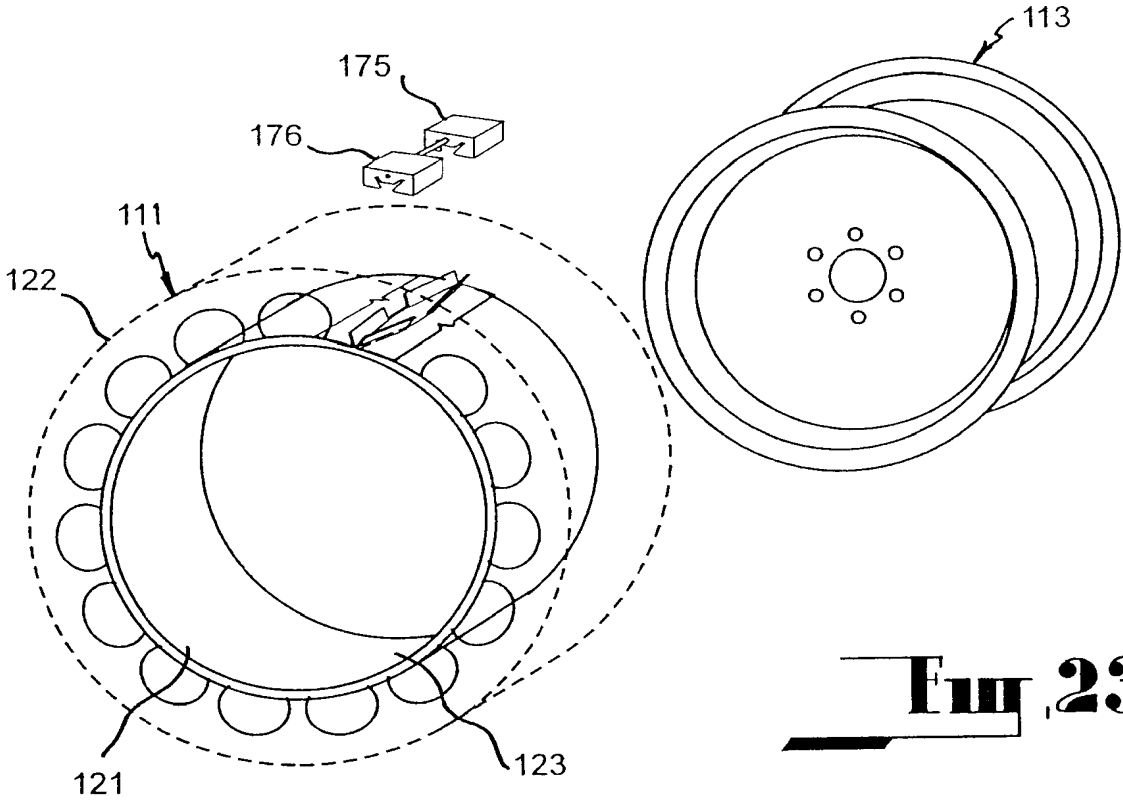


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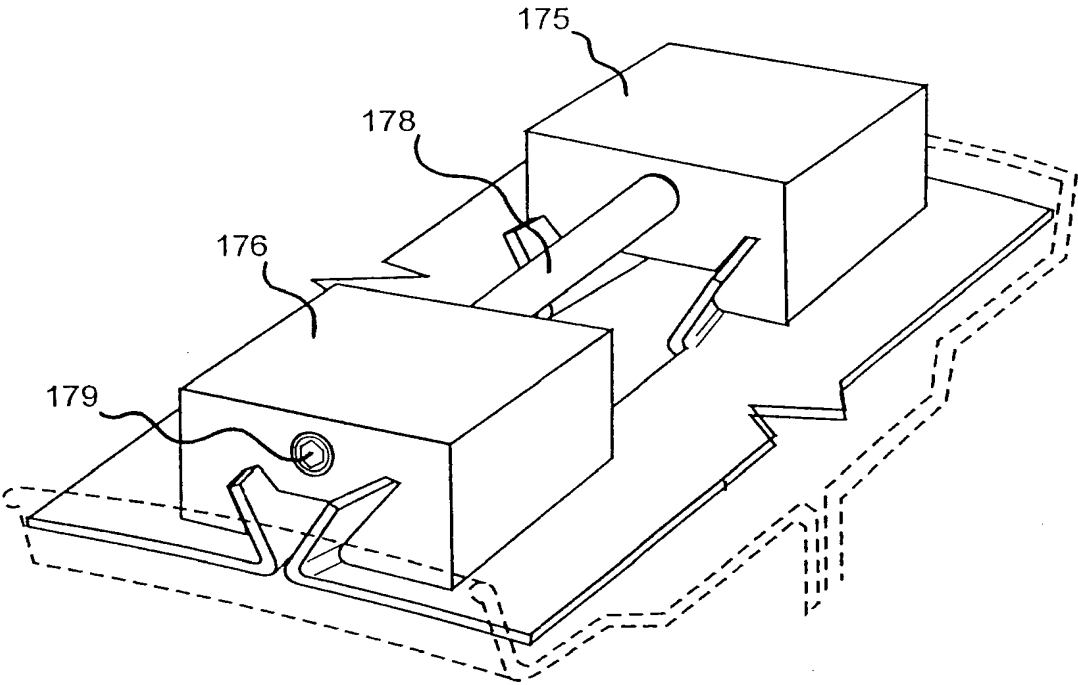


Fig. 24.

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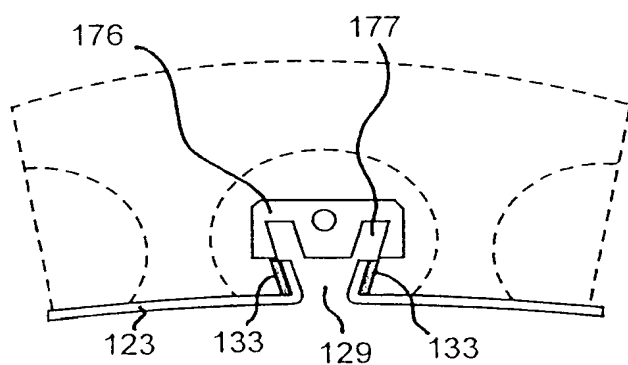


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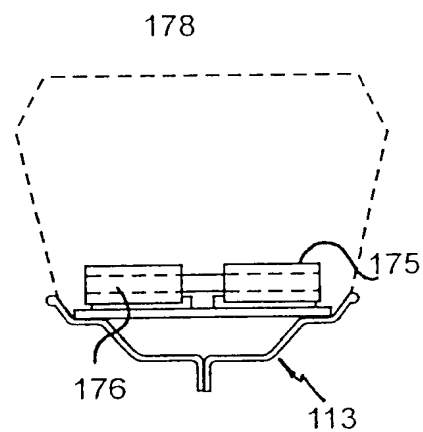


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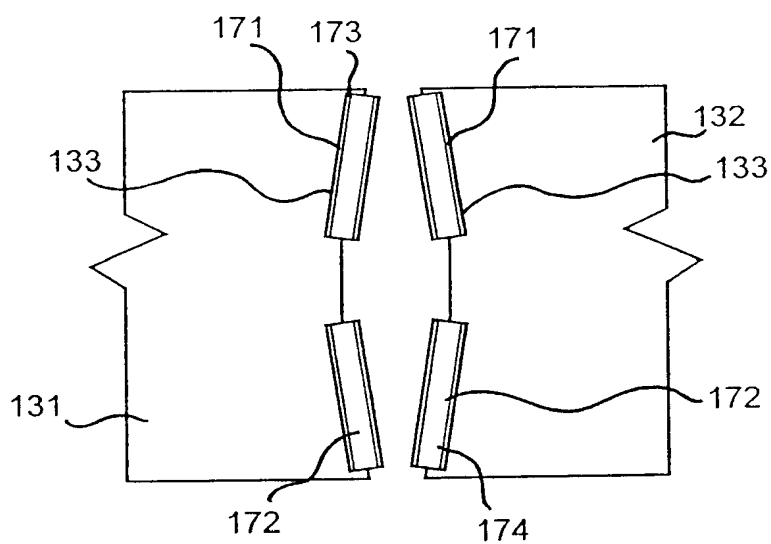
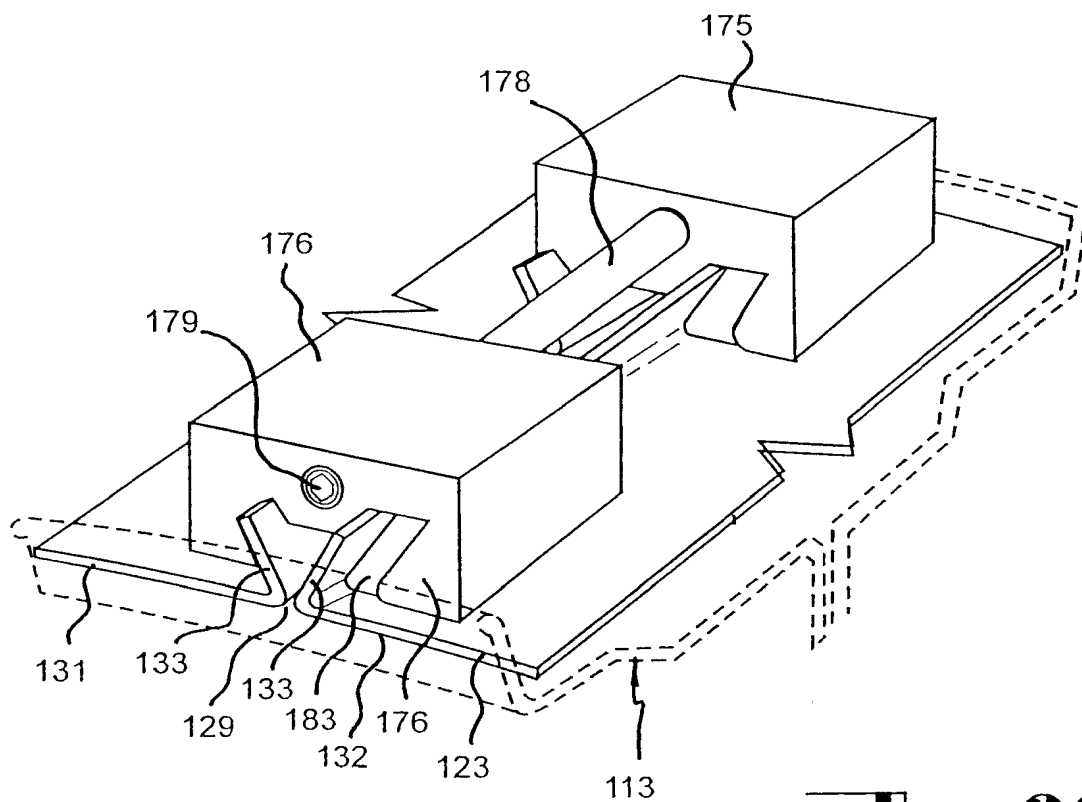
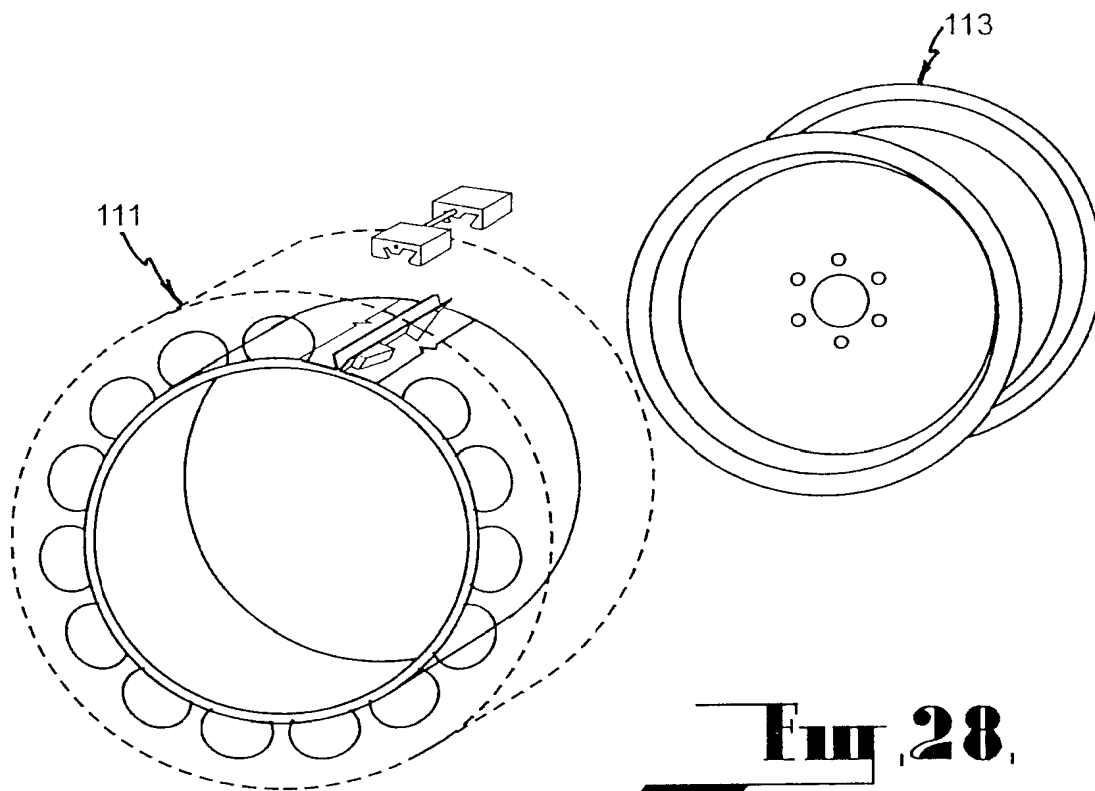


Fig. 27.

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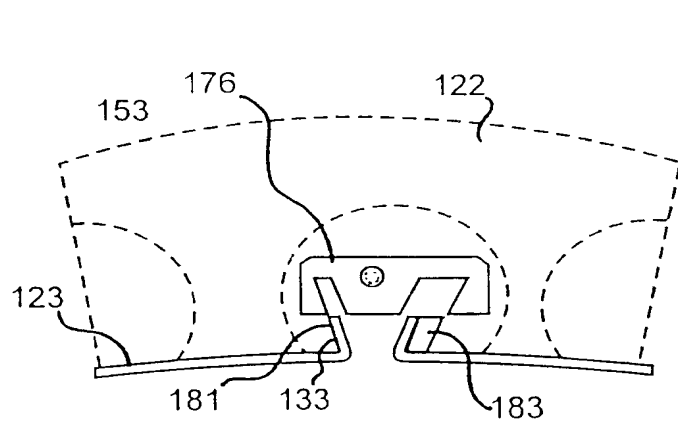


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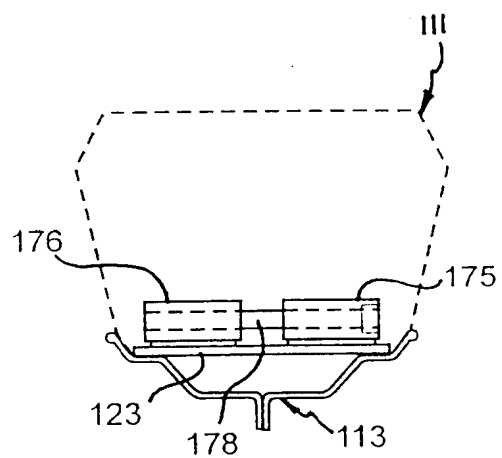


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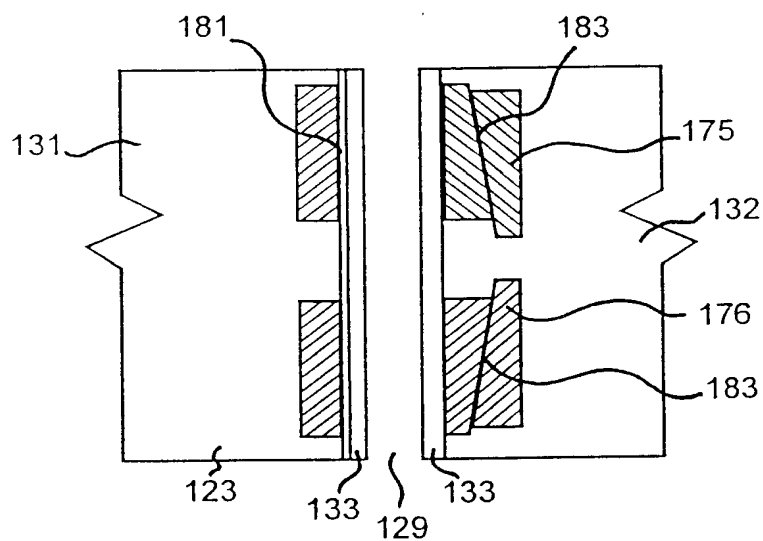


Fig. 32,

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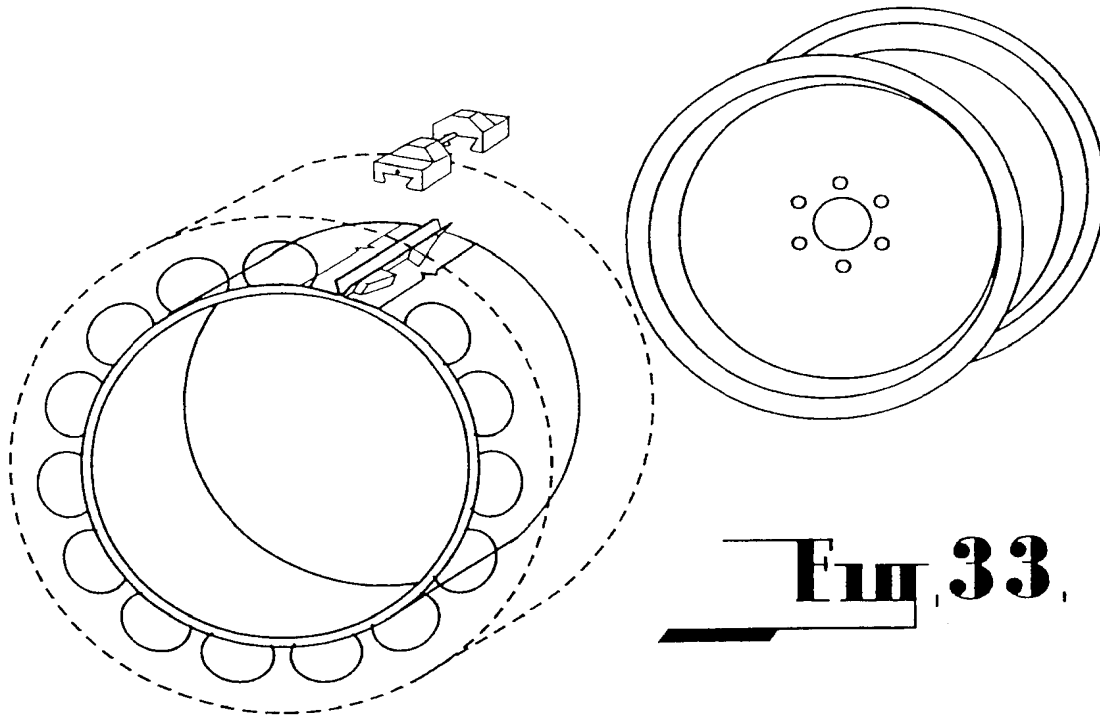


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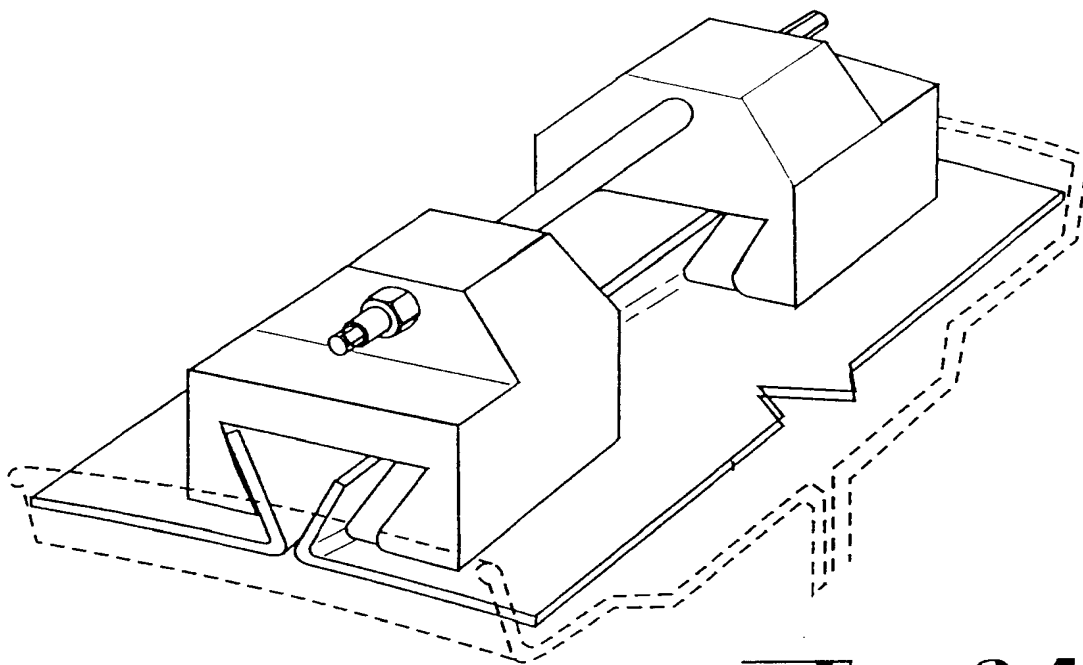
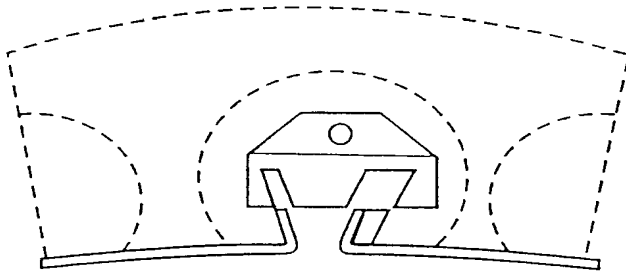
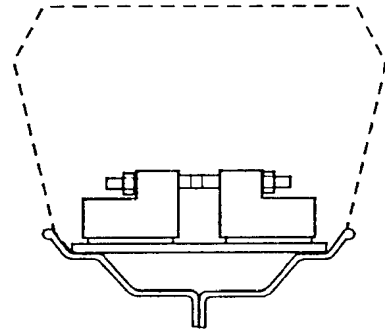
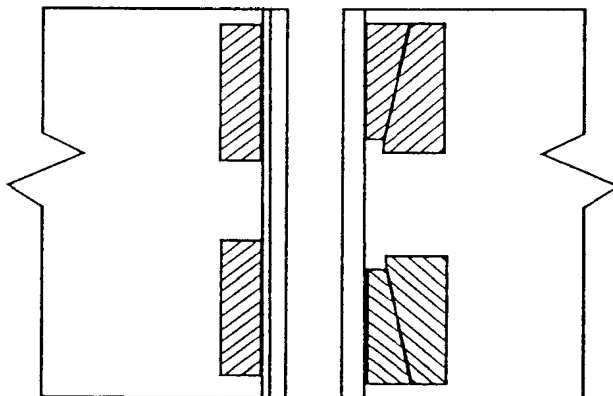


Fig. 34.

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**Fig. 35,****Fig. 36,****Fig. 37,**

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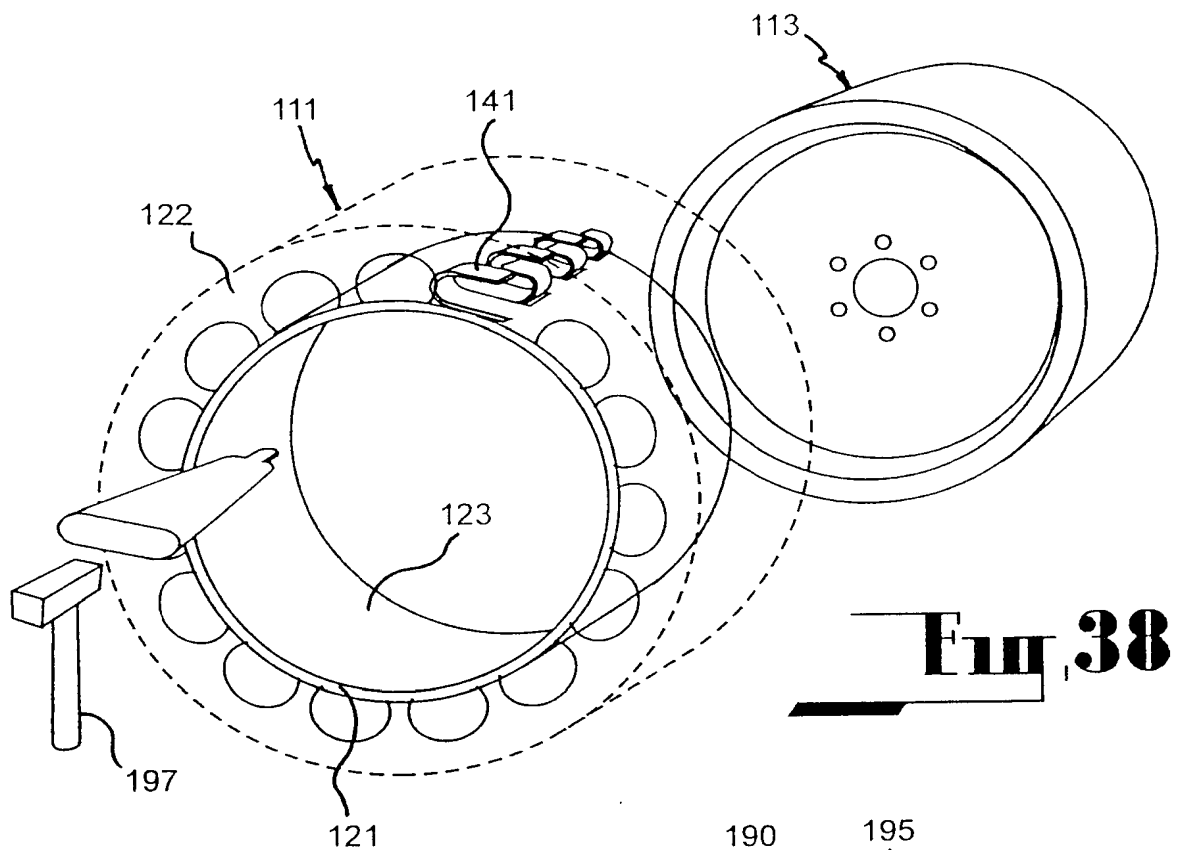


Fig. 38

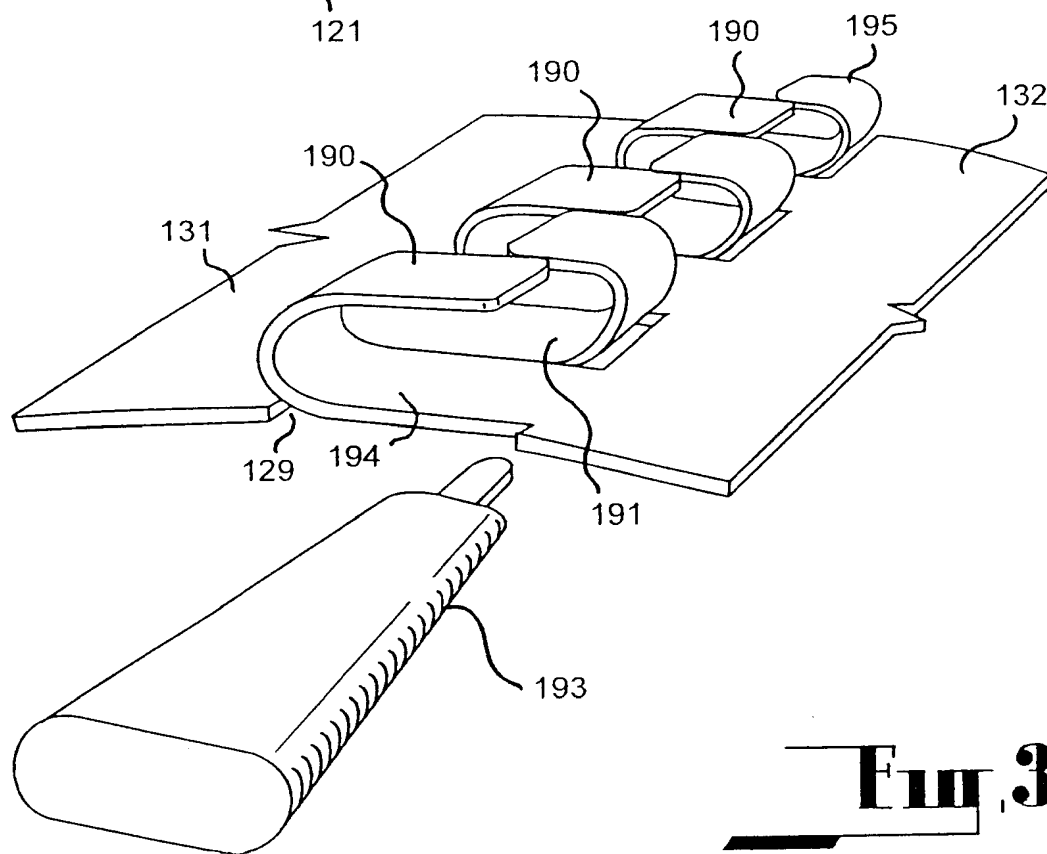


Fig. 39

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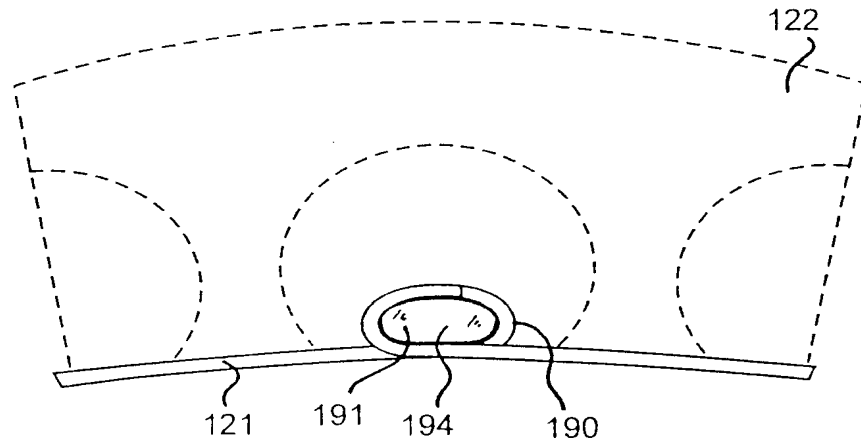


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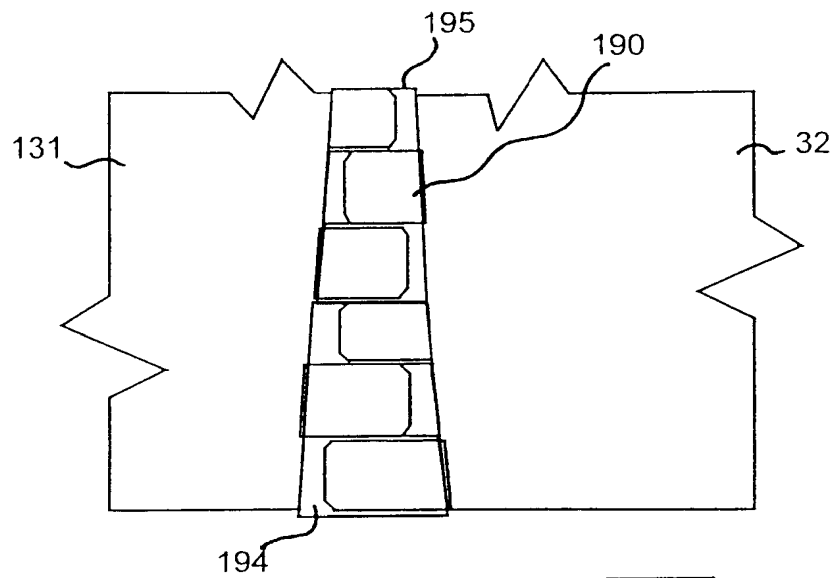


Fig. 41,

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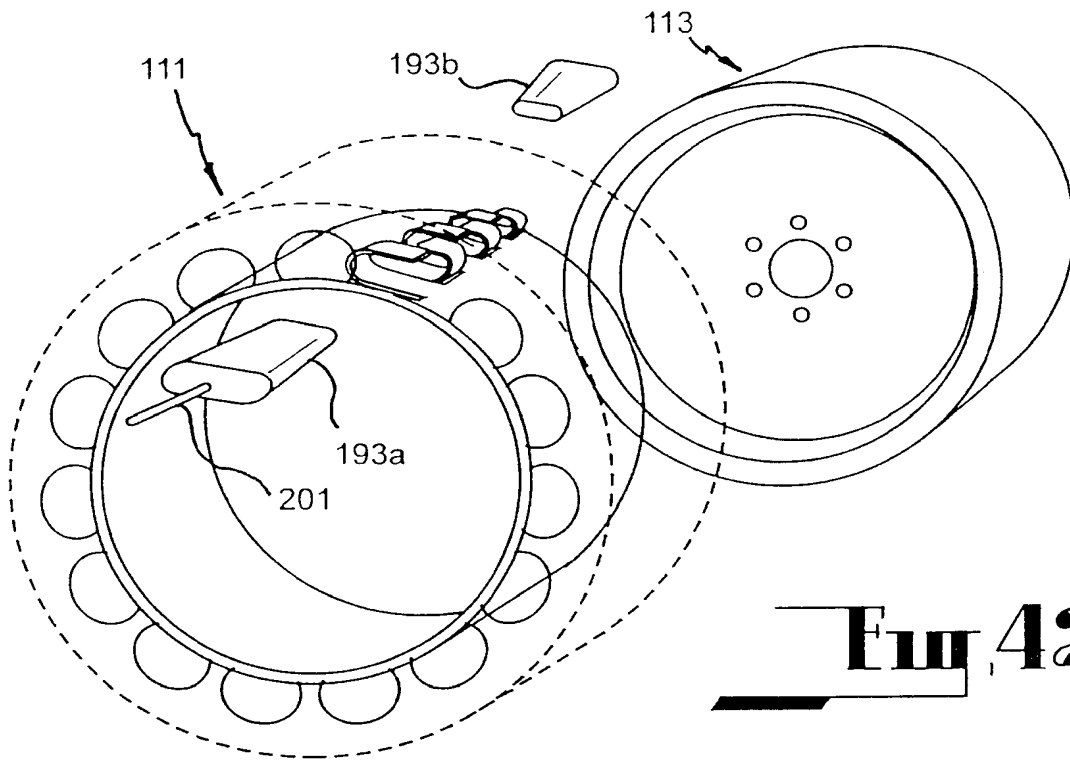


Fig. 42

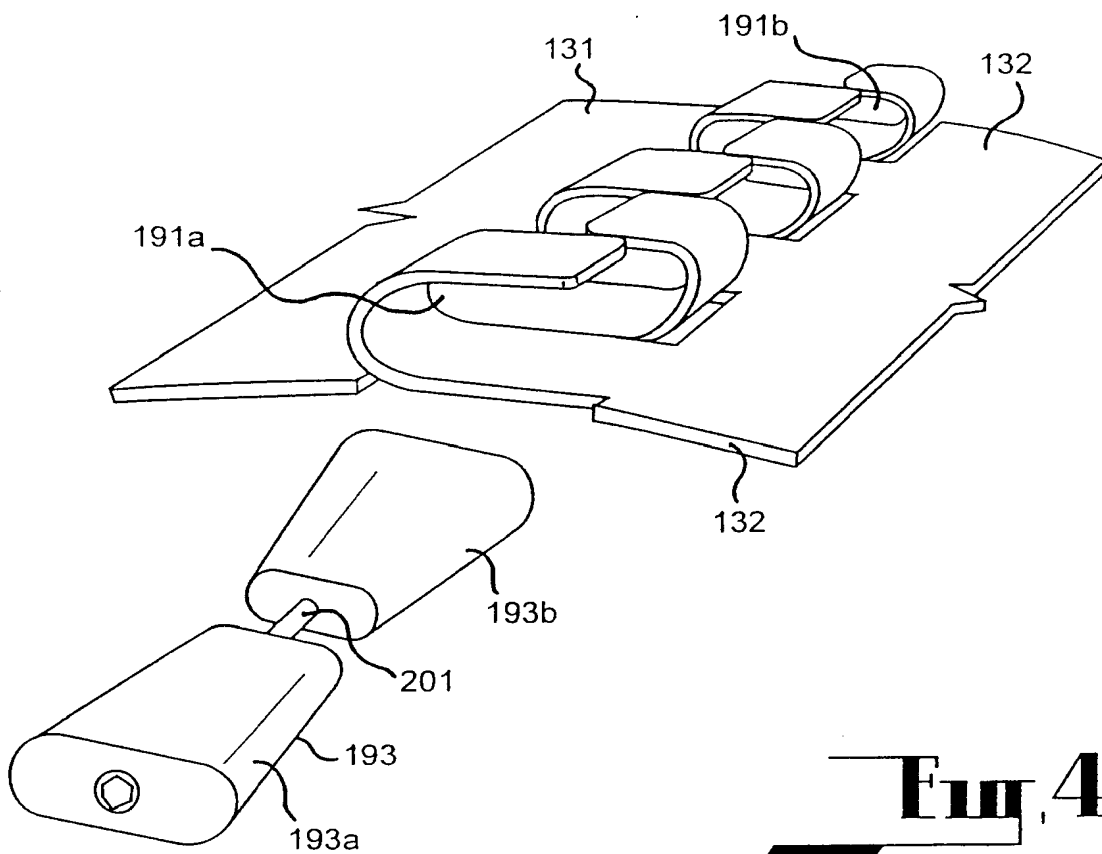


Fig. 43

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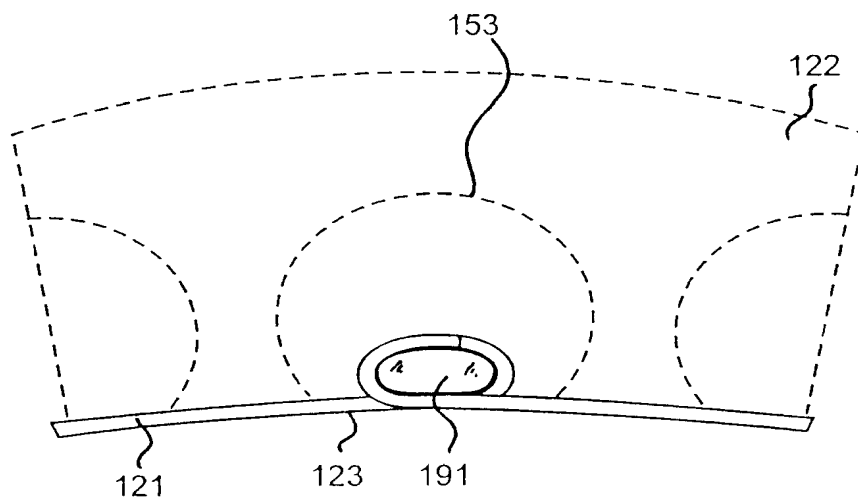


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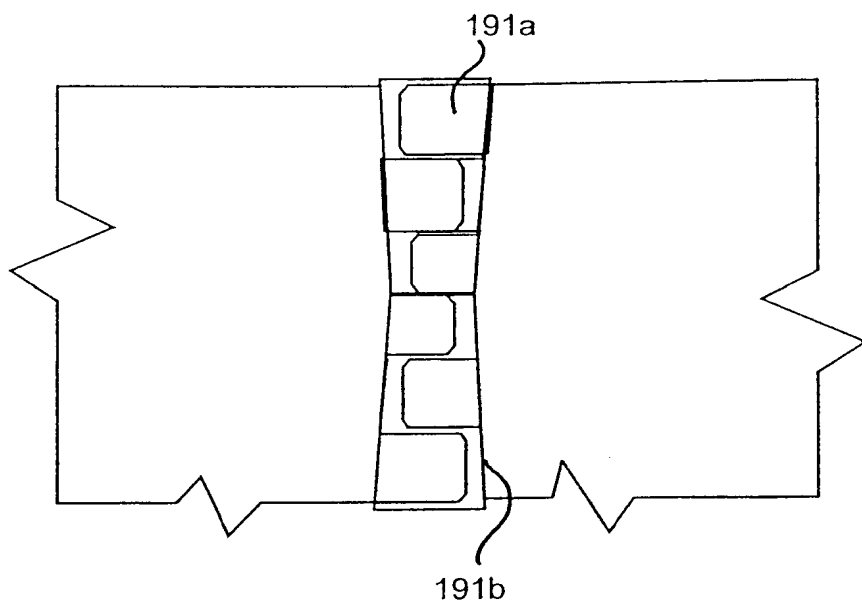
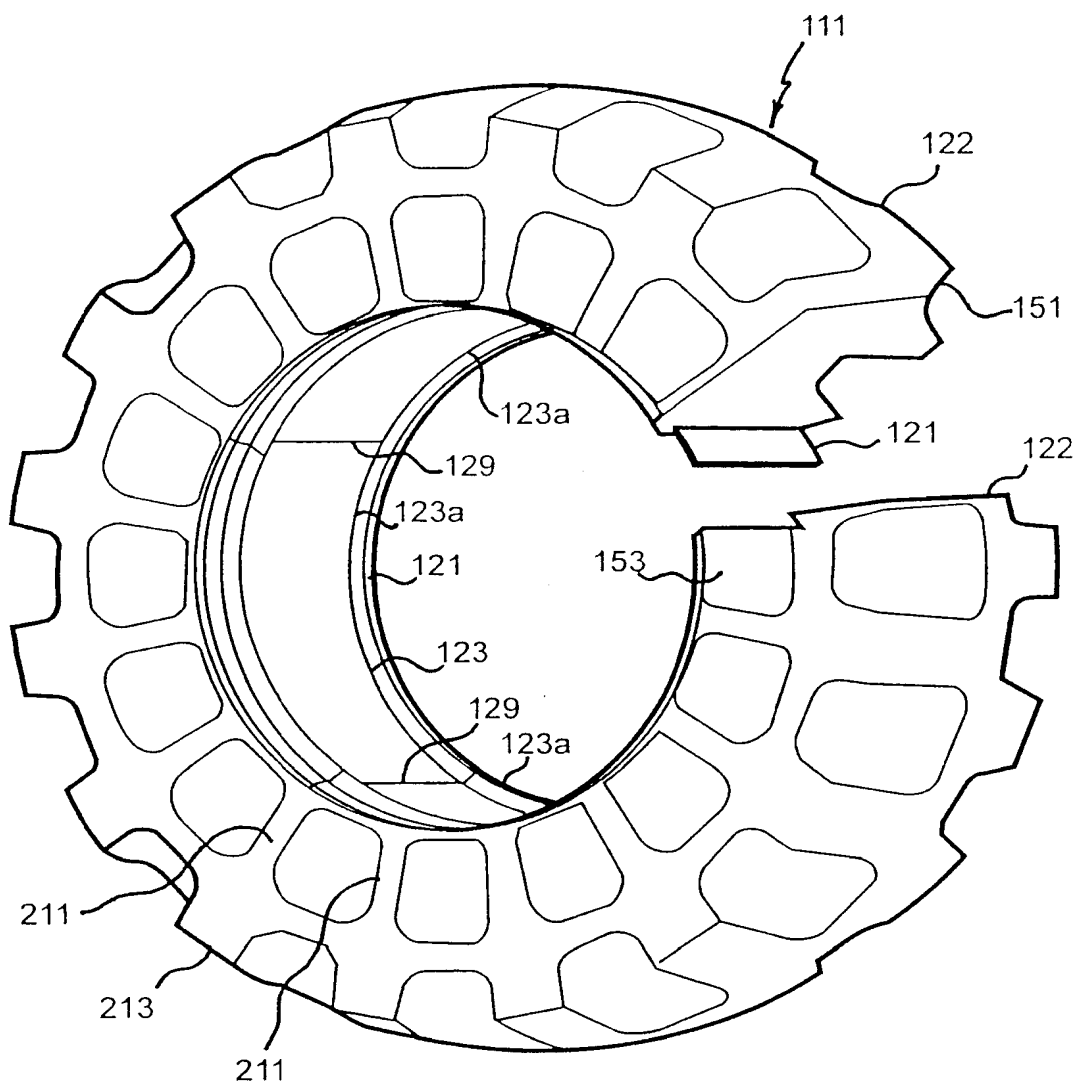
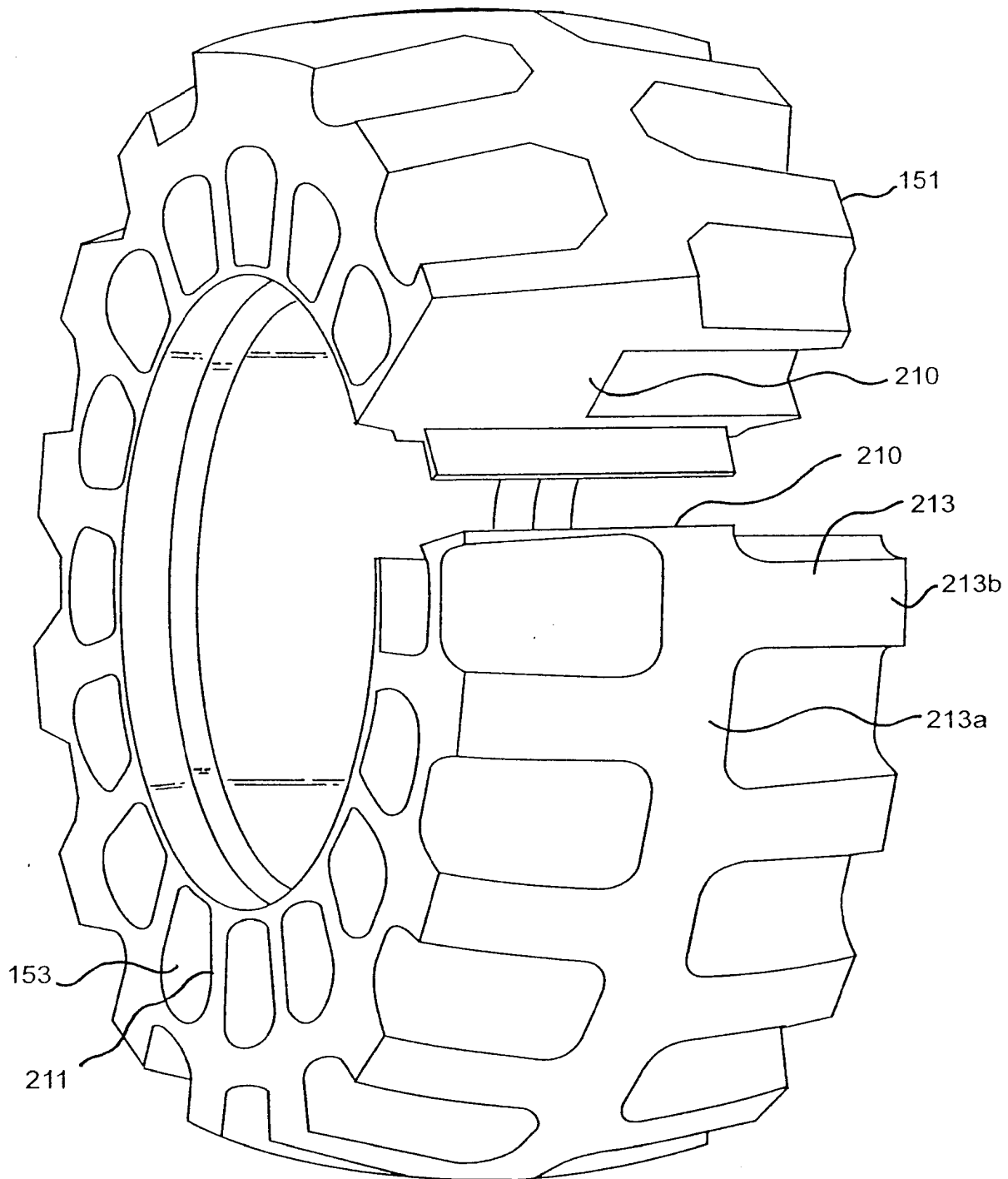


Fig. 45.

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**Fig. 46.**

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**Fig. 47.**

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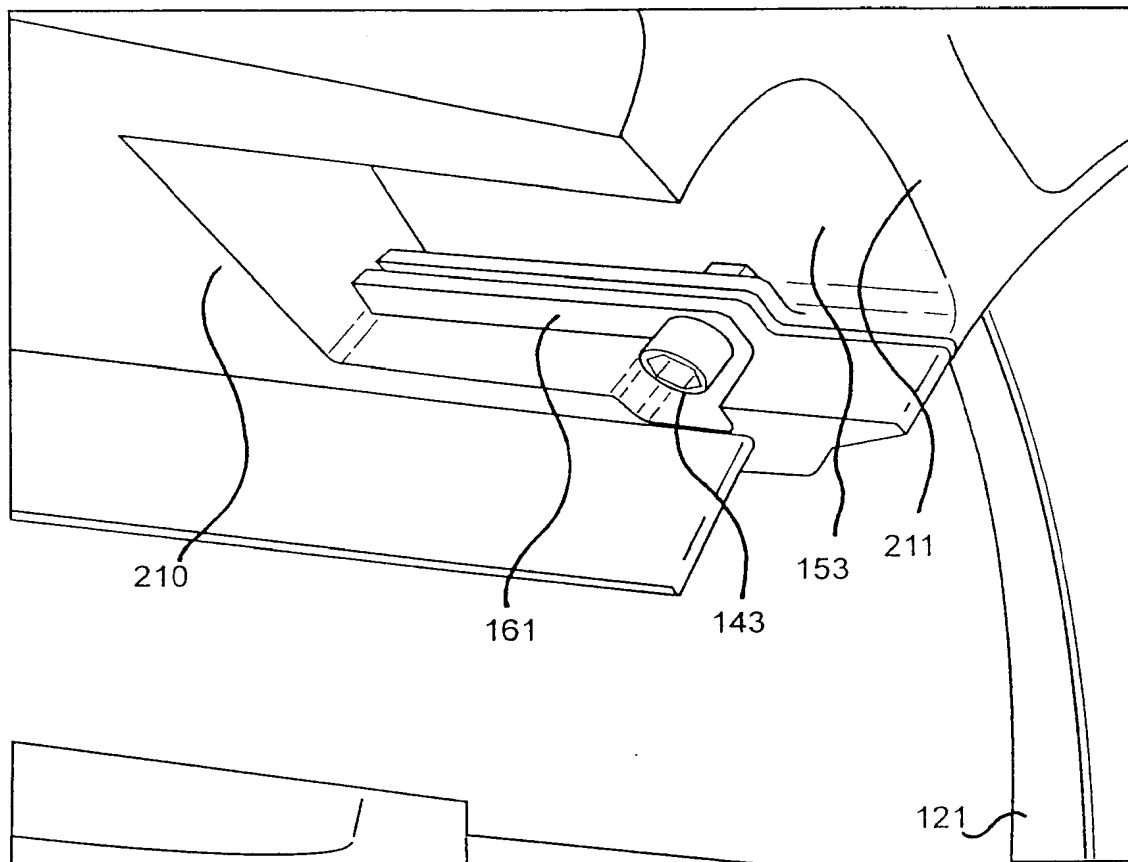
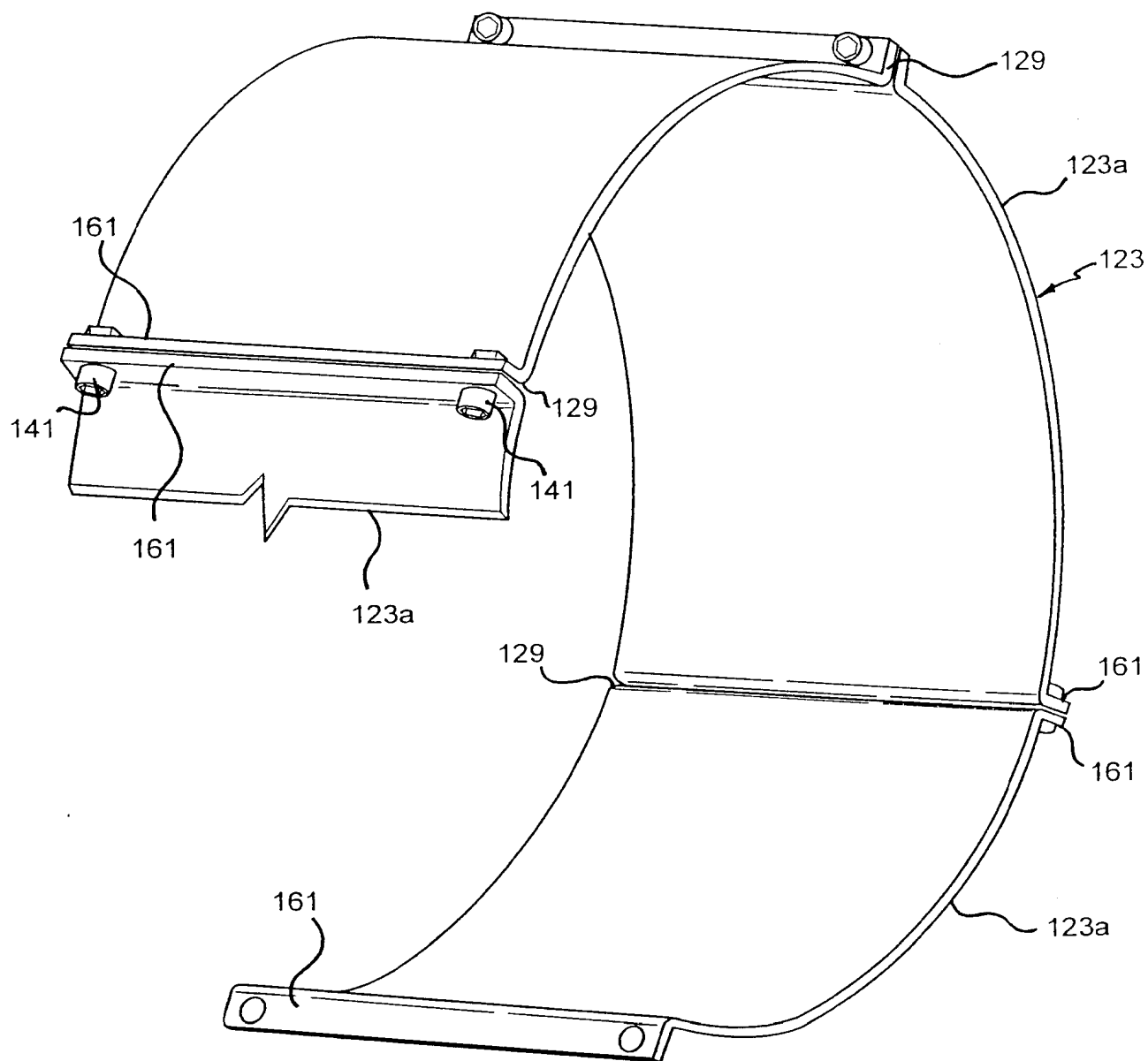


Fig 48

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**Fig. 49**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00653

A. CLASSIFICATION OF SUBJECT MATTER																						
Int. Cl. ⁷ : B60C 7/28																						
According to International Patent Classification (IPC) or to both national classification and IPC																						
B. FIELDS SEARCHED																						
Minimum documentation searched (classification system followed by classification symbols) IPC: B60C USING KEYWORDS																						
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU: B60C 7/-																						
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT: all areas using keywords: TYRE, TIRE AND MOUNT, SECURE etc AND CONSTRICT, CLAMP, etc AND STRAP, BAND, RING.																						
C. DOCUMENTS CONSIDERED TO BE RELEVANT																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
X	GB 290802 A (NICHOLSON) 24 May 1928 See whole document	1-4, 10, 13-15, 18-19																				
X	DE 2429153 A (CONTINENTAL GUMMI-WERKE) 8 January 1976 See whole document	1-4, 10, 13-15, 18-19																				
X	US 2701601 A (SUTTER) 8 February 1955 See whole document	1-4, 10-13, 15, 18																				
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex																						
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A"</td> <td>document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T"</td> <td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E"</td> <td>earlier application or patent but published on or after the international filing date</td> <td>"X"</td> <td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L"</td> <td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y"</td> <td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O"</td> <td>document referring to an oral disclosure, use, exhibition or other means</td> <td>"&"</td> <td>document member of the same patent family</td> </tr> <tr> <td>"P"</td> <td>document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family	"P"	document published prior to the international filing date but later than the priority date claimed		
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Date of the actual completion of the international search 7 July 2000		Date of mailing of the international search report 12 JUL 2000																				
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustrialia.gov.au Facsimile No. (02) 6285 3929		Authorized officer I.A. KILBEY Telephone No : (02) 6283 2115																				

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00653

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DD 214809 A (VEB SCHWARZHEIDE) 24 October 1984 See whole document	1-5, 10-15, 18-20
X	GB 184708 A (HILL-WOOD) 24 August 1922 See whole document	1,5-9
X	US 3528472 A (KUBASH) 15 September 1970 See whole document	1, 5-9, 17
X	DE 29800079U A (UNIPLAST STAHL & KUNST PRODUKTIONS GMBH) See whole document	1,5-9
X	US 5593520 A (BONI) 14 January 1997 See whole document	1, 5-9
X	WO 96/22891 A (AIRBOSS TYRES PTY LTD) See whole document	1

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU00/00653

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	5593520	EP	600771	FR	2698823		
WO	96/22891	AU	44751/96	BR	9606840	EP	873250
		GB	2297298	PL	321510	ZA	9600498
END OF ANNEX							